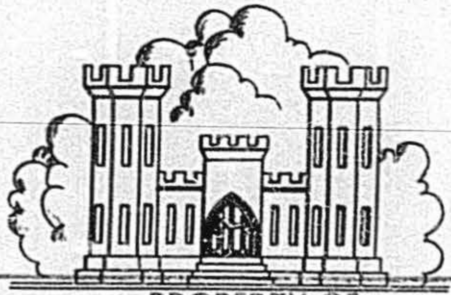
SERIAL NO....64....

REPORT OF SURVEY
FOR

FLOOD CONTROL AND ALLIED PURPOSES

SAN FRANCISQUITO CREEK
SANTA CLARA AND SAN MATEO COUNTIES
CALIFORNIA

JANUARY 1961



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CORPS OF ENGINEERS

SAN FRANCISCO, CALIFORNIA

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12-1967
PG 1 OF 33

SYLLABUS

San Francisquito Creek enters San Francisco Bay about 25 miles south of the city of San Francisco. This stream flows through the highly urbanized areas of southern San Mateo County and northern Santa Clara County and drains an area of 38.4 square miles on the easterly slope of the Santa Cruz mountains.

Periodic floods, particularly the record flood in 1955, caused extensive damages in the flood plain and led to requests by local interests for Federal assistance in providing flood protection. The District Engineer finds that future uncontrolled flows on San Francisquito Creek may be expected to cause damages averaging $516,000 annually. He finds that flood protection by channel improvements is not economically justified principally because of the high cost of rights-of-way through a residential area. He finds, however, that a high degree of flood protection could be achieved by construction of a 12,600 acre-foot capacity multiple-purpose reservoir; that the provision of basic recreational facilities in conjunction with the flood control feature would provide for public use of the proposed project; and, that storage capacity in addition to that needed for flood control, could be provided in the reservoir for water conservation which would augment the existing water supply for domestic and industrial uses in the vicinity; and that construction of such multiple-purpose works is feasible from an engineering standpoint and is economically justified. The estimated project cost is $8,389,000 (exclusive of preauthorization study costs of $76,000). The estimated non-Federal costs would be $2,354,000 for lands and relocations allocated to the flood control function and $1,288,000 for the water supply function. The estimated net Federal cost is $4,747,000. The estimated total Federal construction cost is $6,035,000 of which $1,288,000 is for water supply. The costs of the water supply function would be repaid to the United States Treasury in accordance with the Water Supply Act of 1958.

The District Engineer therefore recommends construction of a project on San Francisquito Creek consisting of a multiple-purpose reservoir at an estimated project cost of $8,389,000. He also recommends that the Federal government acquire all lands, provide basic recreational facilities and perform all construction including relocation. Also, that construction will be initiated when local interests give assurances satisfactory to the Secretary of the Army that they will: (1) contribute in cash, prior to the start of construction of the project, funds equivalent to that portion of the cost of lands, easements, rights-of-way and relocations allocated to flood control, being 75.7 percent of the total cost of those items now estimated at $2,354,000; (2) repay to the United States Treasury 15.3 percent of the total project cost now estimated at $1,288,000 plus interest during construction, in not more than 50 installments with interest at the rate established at the time of construction by the Secretary of the Treasury, in consideration of the water conservation benefits; (3) maintain and operate the project with operations for flood control to be in accordance with regulations prescribed by the Secretary of the Army; (4) hold and save the United

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12a-1967
PG 2 OF 35

States free from damages due to the constructed works; (5) satisfy all claims concerning water rights arising from the construction, maintenance and operation of the improvements; (6) enter into an agreement among themselves as to the method of regulation for water conservation subject to flood control priority; and (7) prevent any encroachment of the stream channel downstream from the dam to the mouth which would interfere with the proper functioning of the improvements or lessen their beneficial effects, or reduce the flood carrying capacity existing in 1960, or in any event, to less than 3,500 c.f.s.

REPORT OF SURVEY
FOR
FLOOD CONTROL AND ALLIED PURPOSES

SAN FRANCISQUITO CREEK
SANTA CLARA AND SAN MATEO COUNTIES, CALIFORNIA

TABLE OF CONTENTS

Paragraph	Title	Page
	AUTHORITY	1
	EXTENT OF INVESTIGATION	2
2	FIELD SURVEYS	2
3	OFFICE STUDIES	2
4	PUBLIC CONTACTS AND CONSULTATIONS	2
	PRIOR REPORTS	3
5	REPORTS BY THE CORPS OF ENGINEERS	3
6	REPORTS BY OTHERS	3
	DESCRIPTION	3
7	LOCATION AND EXTENT	3
8	STREAMS	3
9	TOPOGRAPHY	4
10	GEOLOGY AND SOILS	4
13	STREAM SLOPES	5
14	CHANNEL CHARACTERISTICS	5
16	VEGETATION	5
17	EXISTING MAPS AND CHARTS	6
18	MAPS ACCOMPANYING REPORT	6
	ECONOMIC DEVELOPMENT	6
19	POPULATION	6
20	LAND USE, DEVELOPMENT AND INDUSTRY	7
22	TRANSPORTATION FACILITIES	7
23	NAVIGATION	7
24	POWER	8
25	IRRIGATION	8
26	WATER SUPPLY AND STREAM POLLUTION	8

MICROFILMED
12-1967
PG 4 OF 35

TABLE OF CONTENTS (continued)

Paragraph	Title	Page
	CLIMATOLOGY	8
27	CLIMATE	8
28	TEMPERATURE	8
29	PRECIPITATION	8
30	IMPORTANT STORMS	9
31	STANDARD PROJECT STORM	9
	RUNOFF AND STREAMFLOW DATA	9
32	RUNOFF	9
33	STREAM-GAGING STATIONS	9
	FLOODS OF RECORD	10
34	FLOOD CHARACTERISTICS	10
35	IMPORTANT FLOODS	10
36	FLOOD FREQUENCY	11
	STANDARD PROJECT FLOOD	11
37	GENERAL	11
	MAXIMUM PROBABLE FLOOD	11
38	GENERAL	11
	EXTENT AND CHARACTER OF FLOODED AREA	12
39	FLOOD PLAIN AREA	12
40	TYPE AND VALUE OF IMPROVEMENTS IN FLOOD PLAIN	12
42	EFFECT OF FLOOD ON PROPERTY VALUES	13
43	POPULATION AND DEVELOPMENT	13
44	HIGHWAYS, RAILROADS AND BRIDGES	13
	FLOOD DAMAGES	13
45	FLOOD DAMAGE SURVEYS	13
46	FLOOD DAMAGES	13
50	AVERAGE ANNUAL PRIMARY FLOOD DAMAGES	14
51	AVERAGE ANNUAL DAMAGES UNDER FUTURE DEVELOPMENT	15

TABLE OF CONTENTS (continued)

Paragraph	Title	Page
	EXISTING CORPS OF ENGINEERS PROJECTS	15
52	FLOOD CONTROL PROJECTS	15
	IMPROVEMENTS BY OTHER AGENCIES	15
53	FEDERAL	15
54	NON-FEDERAL	15
56	PRIVATE INTERESTS	16
	IMPROVEMENTS DESIRED	17
57	PUBLIC HEARINGS	17
59	IMPROVEMENTS DESIRED	17
61	JUSTIFICATION FOR IMPROVEMENT DESIRED	18
62	LOCAL COOPERATION OFFERED	18

FLOOD PROBLEMS AND SOLUTIONS CONSIDERED

63	FLOOD PROBLEMS	18
64	SOLUTIONS CONSIDERED	19
67	RELATED WATER RESOURCES DEVELOPMENT	19
	FLOOD CONTROL PLANS	20
69	DESCRIPTION	20
70	RESERVOIR AREA	20
71	GEOLOGY AND SOILS, AND CONSTRUCTION MATERIALS	20
73	FEATURES OF THE DAM	21
74	FEATURES OF THE SPILLWAY	21
76	FEATURES OF THE OUTLET WORKS	21
77	DISTRIBUTION OF RESERVOIR CAPACITY TO PROJECT PURPOSES	22
80	DEGREE OF FLOOD PROTECTION PROVIDED	22
81	RELOCATION OF UTILITIES	22
83	METHOD OF RESERVOIR REGULATION	23
	MULTIPLE-PURPOSE FEATURES	24
85	WATER CONSERVATION	24
86	RECREATION AND FISH AND WILDLIFE	24

MICROFILMED
12-1967
PG 5 OF 35

TABLE OF CONTENTS (continued)

Paragraph	Title	Page
	ESTIMATE OF FIRST COST AND ANNUAL CHARGES	25
88	FIRST COST	25
89	ANNUAL CHARGES	26
	ESTIMATE OF BENEFITS	27
90	TYPES OF BENEFITS	27
91	FLOOD CONTROL BENEFITS	27
95	BENEFITS FROM HIGHER LAND UTILIZATION	28
96	INTANGIBLE FLOOD CONTROL BENEFITS	28
97	SUMMARY OF AVERAGE ANNUAL FLOOD CONTROL BENEFITS	28
98	WATER CONSERVATION BENEFITS	29
99	RECREATIONAL BENEFITS	29
100	SUMMARY OF EVALUATED BENEFITS	29
101	COMPARISON OF BENEFITS AND COSTS	30
	LOCAL COOPERATION	30
102	FACTORS GOVERNING REQUIRED COOPERATION	30
104	REQUIRED LOCAL COOPERATION	30
	ALLOCATION OF COSTS	31
105	ALLOCATION OF COSTS AMONG PURPOSES	31
106	APPORTIONMENT OF COSTS AMONG INTERESTS	31
107	METHOD OF FINANCING FIRST COSTS	32
108	COORDINATION WITH OTHER FEDERAL AGENCIES	32
116	COORDINATION WITH THE STATE OF CALIFORNIA	34
117	COORDINATION WITH LOCAL INTERESTS	34
119	REVIEW BY OTHER AGENCIES	
	DISCUSSION	34
	CONCLUSIONS	37
	RECOMMENDATIONS	37

U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO
CORPS OF ENGINEERS
180 New Montgomery Street
San Francisco, California

SPNGP

SUBJECT: Report of Survey on San Francisquito Creek, San Mateo and Santa Clara Counties, California, for Flood Control and Allied Purposes

THRU: Division Engineer
U.S. Army Engineer Division, South Pacific
San Francisco, California

TO: Chief of Engineers
Department of the Army
Washington, D. C.

AUTHORITY

1. This report is submitted pursuant to Section 4 of the Flood Control Act approved August 18, 1941 (Public Law No. 228, 77th Congress), which reads, in part, as follows:

> Section 4. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the following-named localities . . .
>
> * * *
>
> San Francisquito Creek, San Mateo and Santa Clara Counties, California
>
> * * *

A preliminary examination report on San Francisquito Creek for flood control dated April 1942 submitted by the District Engineer recommended that a survey for flood control and allied purposes

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12-1967
PG 6 OF 35

be authorized. After reviewing the report, the Board of Engineers for Rivers and Harbors recommended that a survey be made. The Chief of Engineers authorized the survey on June 6, 1945.

EXTENT OF INVESTIGATION

2. FIELD SURVEYS

Instrumental surveys were made and aerial photographs taken in 1956 along San Francisquito Creek. Data thus obtained included cross sections (at intervals of about 0.2-mile outside of highly developed areas and at closer intervals inside these areas), stream profiles, high water marks and damsite topography. Photographs recorded the degree of urbanization and encroachment upon the creek. Field investigations were made of channel banks to determine flood damages to residences, commercial and urban properties, crops, agricultural lands, and public properties and utilities. The District Engineer personally made a reconnaissance of the area.

3. OFFICE STUDIES

Office studies included an estimation of direct losses from particular floods and average annual flood damages, investigation of water supply problems, and hydrologic studies of runoff and flood characteristics, the development of frequency curves, derivation of the design flood, hydraulic studies of channel capacities, and design of channels, dam and reservoir features, the estimation of benefits and the allocation of costs. The most feasible plan of improvement was determined from studies of alternative methods for controlling floods, flood control storage requirements, water conservation yields, costs of alternative water supplies, and project costs and benefits.

4. PUBLIC CONTACTS AND CONSULTATIONS

Public hearings were held on February 17, 1942 in connection with the preliminary examination report and on February 7, 1956 in connection with this report. Subsequent meetings and conferences were held with representatives of the city of Palo Alto, Stanford University, and the California State Department of Water Resources.1/ The results of these meetings are discussed in later paragraphs of this report. After the formulation of an adequate plan of improvement, the District Engineer in April 1958 presented an appraisal of possibilities of alleviating the flood problem to representatives of the local people. The plan submitted for their consideration and accepted at that time is presented in this report.

1/ Formerly the Division of Water Resources of the California State Department of Public Works.

PRIOR REPORTS

5. REPORTS BY THE CORPS OF ENGINEERS

There have been no prior Corps of Engineers reports on flood control in the San Francisquito Creek drainage basin.

6. REPORTS BY OTHERS

The Department of Water Resources, in cooperation with Santa Clara County, has prepared a special report on water problems of Santa Clara Valley. The report (Bulletin No. 7, Santa Clara Valley Investigation, 1955) recommended a reservoir on San Francisquito Creek upstream from the city of Palo Alto and Menlo Park. In addition, the Department of Water Resources in a report, titled "California Floods of December 1955" emphasizes importance of surface storage reservoirs in reducing flood hazards. A consultant engaged by the city of Palo Alto issued a report dated August 1952 on ways and means of protecting the city's ground water supply. These reports also cited importance of surface storage reservoirs for retarding flood flows. Pertinent material in these reports has been used in this report.

DESCRIPTION

7. LOCATION AND EXTENT

San Francisquito Creek drainage basin is located on the easterly slope of the Santa Cruz mountains at the southern extremity of the San Francisco Peninsula. The creek enters San Francisco Bay about 25 miles south of San Francisco. The area adjacent to the channel below river mile 6.5 comprises a flood plain of some eight square miles which is almost indefinable. The drainage basin area as published in United States Geological Survey papers is 38.4 square miles above the former Palo Alto gage at mile 2.1. Overbank flow into the flood plain does not return to the creek because the channel banks are higher than the adjacent ground. As a result, flood flows from San Francisquito Creek are impounded in the adjacent basins until the local drainage systems are able to carry off the impounded floodwater. The total area affected by San Francisquito Creek flood water is about 45 square miles. The extent and character of the flood plain and channel conditions are discussed in subsequent paragraphs of this report and in the Appendix.

8. STREAMS

Corte Madera, Alambique and Martin Creeks drain the upper watershed of San Francisquito Creek above Searsville Lake, a water supply reservoir constructed by Stanford University. San Francisquito Creek begins at the

MICROFILMED
12-1967
PG 2 OF 35

outlet of Searsville Dam and flows 12.7 miles in a northeasterly direction to San Francisco Bay. The principal tributaries below Searsville Lake are: West Union and Bear Creeks from the northwest and Los Trancos Creek from the southeast. The narrow outlet portion of the drainage basin and the stream follows along the crest and southerly slope of an extensive alluvial cone.

9. TOPOGRAPHY

Topographically, the general locality consists of a mountainous ridge with peaks as high as 2,650 feet above sea level, and a gently sloping plain extending from the foot of the hills, at about elevation 150 to the marshland adjoining San Francisco Bay. Practically all flood damage is concentrated in this sloping plain. The elevation distribution of the affected area follows:

Elevation (feet)	Topography (type)	Area	
		Square Miles	Percent
0 - 150	Flat	7.4	16.4
150 - 1,000	Foothill	23.5	52.0
1,000 - 2,000	Mountainous	12.4	27.8
Above 2,000	Peaks	1.7	3.8
Total (above mouth)		45.0	100.0

10. GEOLOGY AND SOILS

The geology of the basin is typical of the central Coast Range of California. Structurally, the basin is divided into four sections, the Santa Cruz Mountains in the upper portions, a rift valley, the hilly section, and the outlet portion on the San Francisquito alluvial cone. The San Andreas Fault passes through the rift valley in a northwesterly direction and is the basis of the valley's formation. This fault can be traced through San Mateo County and hundreds of miles beyond.

11. The basin soils are loams, chiefly of the Altamont series in the mountainous area and the Pleasanton series in the rift valley and on the alluvial cone.

12. Foundation materials along San Francisquito Creek upstream from the marshland near the mouth are suitable for construction of flood control works such as levees, dams, floodwalls, and similar structures. Impervious earthfill material suitable for use in embankments is available in the basin. Construction materials are available within 50 miles of the stream. Geology and soils and construction materials are discussed further in subsequent paragraphs of this report and in Appendix B.

13. STREAM SLOPES

The stream has a comparatively uniform slope of 50 feet per mile as it progresses downstream from river mile 12.7 (Searsville Lake) to river mile 5.8. From river mile 5.8 to the mouth, the slope is about 13 feet per mile. The principal tributaries have slopes varying from 50 to 100 feet per mile in the lower two-thirds of their lengths and as much as 500 feet per mile in the upper reaches. The steep slopes are typical of the smaller tributaries in this mountainous area. Stream profiles and slope characteristics are shown in Appendix A.

14. CHANNEL CHARACTERISTICS

In the foothill and mountainous parts of the watershed, the stream channel is adequate for all flows of record. Where the stream emerges from the hills at river mile 7.5, its channel has a capacity of 12,000 c.f.s. The channel capacity decreases downstream, to approximately 9,000 c.f.s. at river mile 5.0; 6,000 c.f.s. at river mile 4.2; 4,500 c.f.s. at river mile 3.9; and from river mile 2.0 to Bayshore Freeway bridge river mile 1.5 the channel capacity is limited to 3,500 c.f.s. due to the adverse alignment of the channel and resulting poor approach conditions at the bridge. Downstream from the Bayshore Freeway bridge the channel capacity has been increased to 5,000 c.f.s. by construction of a levee with three feet of freeboard. Depths of the channel from the hills to Bayshore Freeway average between 25 and 13 feet and widths vary from 48 to 75 feet. Downstream from Bayshore the depths of the channel average between 15 and 19 feet below the top of the levee. Widths between the levees vary from 90 to 150 feet.

3500 C.F.S.

15. Prior to 1900, the channel below river mile 5 was smaller and the stream would overflow during heavy storms. During construction of Stanford University, contractors removed much sand and gravel from the streambed. This practice, now discontinued, resulted in a channel enlargement which materially reduced overflow during the earlier flood periods. However, today these excavations have filled up, thus tending to raise the streambed and causing greater danger from erosion and caving as a result of low flow contact with the softer bank material overlying the gravel stratum. In order to minimize erosion, local interests have stabilized the channel banks substantially by the construction of protective works along the right bank from river mile 2.2 to Bayshore Freeway river mile 1.5.

+ Corps also did same.

16. VEGETATION

The mountainous area is a forest of redwood and Douglas fir trees, few of which have commercial value. The foothills are covered with grass, shrubs, and scattered oak trees. The portion of the basin extending from river mile 7 to the marshland adjoining San Francisco Bay is an intensely-developed urban area.

MICROFILMED
12-1967
PG 8 OF 35

17. EXISTING MAPS AND CHARTS

Following is a list of the more important published maps and charts relating to the San Francisquito drainage basin which were available during the investigation:

a. Topographic maps. Maps prepared by the United States Geological Survey cover all or part of the basin at scales of 1:50,000; 1:62,500; 1:125,000 and 1:24,000.

b. Geologic map. Map of the entire basin at a scale of 1:500,000 prepared by the State of California.

c. Soil survey map. Maps of the State of California and of the San Francisco Bay Region at a scale of 1:125,000 were prepared by the Department of Agriculture in cooperation with the University of California.

d. Map of North Central Coast, California. Map 3, Bulletin 599 at a scale of 1:250,000 prepared by the University of California.

e. Land use survey. Maps of San Mateo and Santa Clara Counties at a scale of 1 inch equals 1 mile, prepared by the California State Division of Water Resources in 1949.

f. Aeronautical charts. Regional chart number 11M at the scale of 1:1,000,000 and sectional chart, San Francisco at the scale of 1:500,000 prepared by the United States Department of Commerce.

g. United States Coast and Geodetic Survey. Chart No. 5531 "San Francisco Bay, Southern Part", and a compilation of aerial photographs, sheets No. 4644 and 4644A.

18. MAPS ACCOMPANYING REPORT

General features of the San Francisquito Creek drainage basin are shown on a general map accompanying this report as Plate 1. General features of a dam and reservoir proposed downstream from Searsville Lake and discussed later in this report are shown on Plate 3.

ECONOMIC DEVELOPMENT

19. POPULATION

From data published by the U.S. Department of Commerce, Bureau of the Census, the population of Palo Alto, the second largest city in Santa Clara County, was 52,281 in April 1960 representing an increase of 105 percent since 1950. Menlo Park, one of the fastest growing cities in San Mateo County, has increased in population 100 percent between 1950 and 1960. The population in April 1960 was 26,957.

20. LAND USE, DEVELOPMENT AND INDUSTRY

It is estimated that nearly 60,000 persons reside within the 38.4 square mile area above the Palo Alto gage drained by San Francisquito Creek and its tributaries. The future of this area is closely related to the growth of San Mateo and Santa Clara Counties. In 1950, those two counties had a combined population of 526,200. By 1960, the population had increased to more than 1,080,000. The population for these two counties is estimated to be 1,340,000 in 1970. Planners concerned with the development of the San Francisquito Creek drainage area, and representing Palo Alto, Menlo Park, the county of San Mateo and Stanford University have estimated the basin population at between 78,000 and 107,000 within a 10- and 15-year period. Due to relatively few vacancies in the flatter lands adjacent to the Bay, most of the new population will be accommodated through the redevelopment in existing acres and subdivisions of the foothill areas within the drainage basin.

21. Palo Alto is a suburban residential city long known for its renowned community center and cultural and recreational resources. It is now a major retail trading center and recently it has added a number of light industries. Its manufacturing plants produce electrical equipment, television sets and instruments; and its administrative offices and laboratory facilities house the division and regional headquarters for many nationally known firms. Adjoining the city is Stanford University and Stanford Research Institute. The institute conducts studies for sponsored projects requiring industrial and economic research. Menlo Park extends east to the San Francisquito Creek boundary which separates it from Palo Alto and the university campus. Between Menlo Park, Palo Alto and the Bay is East Palo Alto, and the western terminus of the Dumbarton bridge. This bridge is the most southerly crossing of San Francisco Bay.

22. TRANSPORTATION FACILITIES

The basin is served by the main coast rail line of the Southern Pacific Company and by local commuter trains, together with local and coastwise bus service. Highway U.S. 101, (El Camino Real), follows the Old Mission Trail of the Padres, via the major communities. Bayshore Highway (U.S. 101 alternate), an industrial highway along the San Francisco Bay shoreline, is being made a six-lane freeway in the basin area. Planned is the Junipero Serra Freeway which would cross the reservoir area and is shown on Plate 2. Several state highways and a number of improved county roads furnish additional traffic arteries to complete the existing transportation system. The Palo Alto Municipal Airport, used by charter and privately owned planes, is in the flood plain near the mouth of San Francisquito Creek.

23. NAVIGATION

There are no navigation improvements or harbors on San Francisquito Creek. The Palo Alto Yacht Club Harbor is about one mile south from the mouth of the creek on Mayfield Slough.

MICROFILMED
12-1967
PG 9 OF 35

24. POWER

No hydroelectric power developments exist in the basin. The creek and its tributaries have a low annual runoff, with all of the flow occurring during the period from December through May inclusive. These conditions do not favor development of power.

25. IRRIGATION

Irrigation water is piped from Searsville Lake for use on the Stanford University campus. Minor quantities of irrigation water are pumped from wells in the lower reaches of the stream for private use.

26. WATER SUPPLY AND STREAM POLLUTION

Local water for domestic and industrial uses is obtained by pumping from wells. Supplemental water is imported and supplied to the area through the city and county of San Francisco's Hetch Hetchy Aqueduct. All municipalities in the basin have sewage treatment plants that discharge into San Francisco Bay. No stream pollution problem is known to exist on San Francisquito Creek.

CLIMATOLOGY

27. CLIMATE

The climate of the San Francisquito Creek drainage basin is characterized by warm, dry summers and mild, wet winters. The dominant influence on climate is the Pacific High Pressure Area.

28. TEMPERATURE

Temperatures as high as 105 degrees and as low as 20 degrees Fahrenheit have been recorded in the San Francisquito Creek drainage basin. Such temperature extremes are rare, however, because of the moderating effect of the Pacific Ocean. The mean annual temperature is approximately 57 degrees. The coldest month is January with an average temperature of 47 degrees. Warmest months are July and August with an average temperature of 65 degrees.

29. PRECIPITATION

Amounts and distribution of rainfall are influenced by orographic effects resulting from the topography of the area. The greatest rainfall occurs in mountainous areas of the drainage basin while the area of least rainfall is adjacent to San Francisco Bay. Snow occasionally falls in winter over higher elevations. The average annual precipitation for the basin is 32 inches, varying from about 16 inches at Palo Alto to more than 42 inches in the Santa Cruz mountains. The monthly variation in rainfall follows a relatively uniform pattern with approximately 90 percent of the annual precipitation falling during the October through March period. The total rainfall in June, July, August and September averages less than 0.5-inch. Rainfall stations in and adjacent to the San Francisquito Creek basin are listed in Appendix A.

30. IMPORTANT STORMS

Since 1892, there have been 11 flood-producing storms over the basin, as follows: February 1894, January 1895, January 1909, January 1911, January 1916, February 1919, February 1940, January 1943, November 1950, December 1955 and April 1958. The average frequency of occurrence is once in about six years.

31. STANDARD PROJECT STORM

The standard project storm was determined by use of storm transposition within a limited region of meteorological homogeneity. Critical storms within this region were transposed over San Francisquito Creek basin and the storm of December 1955 proved to be the most critical and was adopted as the standard project storm. A more detailed description of the derivation of the standard project storm is given in Appendix A.

RUNOFF AND STREAMFLOW DATA

32. RUNOFF

Flood runoff in San Francisquito Creek and its tributaries closely follows the seasonal variation in precipitation. Flood runoff occurs during the winter following periods of intense rainfall, normally preceded by periods of moderate precipitation. From May to October most tributaries have little or no flow. During the low water period, the flow from the upper reaches of San Francisquito Creek, or from the tributaries, usually disappears by diversion or by percolation through the sands and gravels of the creek bed before reaching Highway U.S. 101. The annual runoff measured at the stream-gaging station at Stanford University has varied from about 2,000 to as much as 39,000 acre-feet during the 20 years of record, (1931 to 1941 and 1950 to 1960). The average annual runoff for the period is 15,000 acre-feet, or 400 acre-feet per square mile of drainage area above the station.

33. STREAM-GAGING STATIONS

In 1892 a staff gage was established on San Francisquito Creek at the spillway crest of Searsville Lake dam by the Spring Valley Water Company. Continuous streamflow records were obtained at this gage for the 1892-1913 period. During Stanford University hydraulic studies on

MICROFILMED
12-1967
PG 16 OF 35

water losses in San Francisquito Creek, five stream-gaging stations were operated in the watershed between 1931 and 1941. Two were on San Francisquito Creek, one on Los Trancos Creek, and two on diversion canals. An additional station was established between the two gages on San Francisquito Creek for the October 1934-February 1936 period. The recording stream-gaging station at Stanford (river mile 7.6) was re-established in October 1950 by the United States Geological Survey in cooperation with the Corps of Engineers. Records for this station are published in the United States Geological Survey Water Supply Papers. Other stations in the basin have been discontinued. Data on location, length of record, peak discharges, and other related information for the active and inactive gaging stations in the basin are given in Appendix A.

FLOODS OF RECORD

34. FLOOD CHARACTERISTICS

Floods in the San Francisquito Creek basin are caused entirely by storm rainfall as snowmelt is negligible. The floods are characterized by rapid rise and recession, with flows above 1,500 c.f.s. seldom being sustained for more than six hours. The flood peak occurs within three to four hours after the occurrence of maximum rainfall and recedes almost as rapidly. The flood of 21-24 December 1955 is the largest flood for which a gaged hydrograph is available and was the result of heavy rainfall during a 42-hour period. The runoff hydrograph was characterized by three peaks at approximately 12-hour intervals with a total of 4.23 inches of surface runoff occurring during a period of 60 hours. Detail hydrographs are presented in Appendix A. These peaks caused flooding, and the accompanying high velocities caused bank erosion and scouring in the reach above the Bayshore Highway.

35. IMPORTANT FLOODS

Floods

Data on floods antedating the period of streamflow records on San Francisquito Creek are meager. Information obtained from local residents reveals that bankfull capacity in the lower 5-mile reach of San Francisquito Creek was equalled or exceeded in the years 1894, 1895, and 1909. The flood of 4 January 1895 was the largest during this period with a peak discharge at Palo Alto estimated at about 6,100 c.f.s. During the past 51 years, San Francisquito Creek has equalled or exceeded bankfull capacity nine times, namely, 1909, 1911, 1916, 1919, 1940, 1943, 1950, 1955 and 1958. The largest flood during the 52-year (1906-1958) period occurred 21-24 December 1955. It produced a peak discharge of 5,560 c.f.s. at the stream-gaging station at Stanford University. Total runoff from this flood was 9,000 acre-feet during a 60-hour period. One thousand acre-feet of storage would have reduced this flood to bankfull stage. The storm of 9-15 January 1911 is estimated to have resulted in the greatest volume of runoff during the period of record. The runoff from this storm could have been reduced to bankfull stage with a storage volume of 6,000 acre-feet.

36. FLOOD FREQUENCY

A flood-frequency analysis was made for San Francisquito Creek to derive an estimate of average annual damage for purposes of economic evaluation of possible improvements for flood control. The frequency curve was based on a 64-year period including 17 years of actual gage records. The remaining part of the period was estimated from calculated discharges at Searsville Dam wasteway weir, correlation with San Lorenzo River at Big Trees in the adjoining Santa Cruz County, and from rainfall records. Estimated and observed peaks and the derived frequency curve are shown in Appendix A.

STANDARD PROJECT FLOOD

37. GENERAL

The standard project flood is a hypothetical flood derived in order to establish an upper limit for the design of flood control improvements. A standard project flood at a particular point is determined as the estimated runoff which would result if the standard project storm should occur at a time when conditions were reasonably favorable for flood runoff. The standard project flood was estimated for San Francisquito Creek at the stream-gaging station at Stanford University for the inflow to a proposed reservoir described later in this report and shown on Plate 3. Methods used in the derivation of the standard project flood are presented in Appendix A. The estimated peak discharge for the standard project flood is 13,800 c.f.s. at the stream-gaging station at Stanford and 11,000 c.f.s. inflow at the proposed reservoir. The standard project flood was approved by the Chief of Engineers in January 1957. Twelve thousand acre-feet of storage would be required to reduce the standard project flood to backfull stage downstream from Los Trancos Creek.

MAXIMUM PROBABLE FLOOD

38. GENERAL

The maximum probable flood is a hypothetical flood resulting from the runoff from the maximum probable rainfall estimated by the U.S. Weather Bureau. This flood is derived principally for establishing a basis for spillway design. The maximum probable flood discharge is estimated to be 27,000 c.f.s. at the reservoir site. The derivation of this discharge is described in Appendix A.

MICROFILMED
12-1967
PG 11 OF 35

EXTENT AND CHARACTER OF FLOODED AREA

39. FLOOD PLAIN AREA

Accounts of floods during the 52-year period 1906-1958 indicate that the creek has topped its banks near river mile 4.0 on several occasions downstream from Middlefield Road to San Francisco Bay. During the 1955 flood 1,200 acres of highly urbanized land were inundated. The creek channel follows the crest of the alluvial cone and channel banks are several feet higher than the adjacent ground which slopes away from the stream. As a result, overflowing floodwaters flow to the Bay through adjacent stream channels. On the south side these overflows join Matadero Creek overflow which in turn discharges into the Matadero floodwater basin formed by levees around 600 acres of marshland below Bayshore Freeway and between Mayfield and Charleston Sloughs. In the reach from the Southern Pacific Company's main line railroad to Bayshore Freeway, the flood plains of San Francisquito and Matadero Creeks overlap. Consequently, with coinciding high flows on Matadero Creek the overflow from San Francisquito Creek is impounded. This results in increased depths of flooding until the flow in Matadero Creek recedes permitting drainage of the flooded areas through the cities' storm sewer system. Estimates of damages from possible floods greater than the flood of 1955, were made of flood conditions that would be produced by the standard project flood (13,800 c.f.s. at Stanford University gaging station). Assuming existing channel conditions, it is estimated that such a flood would inundate approximately 5,000 acres including 500 acres of agricultural land. The remaining flooded area consists principally of highly developed urban residential and commercial business properties.

40. TYPE AND VALUE OF IMPROVEMENTS IN FLOOD PLAIN

The flood plain is predominantly residential with some business establishments along Bayshore Highway and University Avenue. Downstream and to the south are located a transpacific radio and telegraph company, the Palo Alto Municipal Golf Course, and the Palo Alto Airport. North of San Francisquito Creek is East Palo Alto and much of the agricultural land. A few industrial developments are located in this area. Most of the area downstream from the highway is below high tide and protected from tidewater and floodflows by levees along San Francisquito Creek and San Francisco Bay. Two through highways and the main coast rail line of the Southern Pacific Company cross the flood plain in a northwest-southeast direction. Roads and utilities crisscross the flood plain area.

41. Value of property in the flood plain was estimated on the basis of 1958 prices for residential, commercial, and agricultural facilities under present economic conditions. Agricultural products of the flood plain are confined, principally, to nursery stock and flowers. Value of the improvements, excluding highways, railroads and public utilities, that would be inundated by the standard project flood is estimated at $275,000,000.

42. EFFECT OF FLOOD ON PROPERTY VALUES

Due to the high demand for land and the lack of frequent flooding in recent years, there has been no noticeable decrease in property values in the flood plain due to vulnerability of flooding. The only lands not presently being used are those east of Bayshore Highway owned and reserved by Palo Alto for a flood basin to contain flood flows during high tide.

43. POPULATION AND DEVELOPMENT

The population in the flood plain of the standard project flood is about 35,000. It is estimated that this will increase about 100 percent during the life of the project. Prior to World War II, the area affected by San Francisquito Creek floods was primarily agricultural. Residential and industrial developments now occupy all but a small part of the former agricultural area. The continued rapid economic growth will require use of the remaining agricultural land in the flood plain for residential and industrial sites within the foreseeable future.

44. HIGHWAYS, RAILROADS AND BRIDGES

As previously mentioned, two through highways and the main coast railroad cross the flood plain. Observations and comparisons of high water marks indicate that bridges and culverts of the interior road system are sufficiently large to permit the unobstructed flow of water with discharges ranging from 4,000 to 5,000 c.f.s. Any discharge above 6,000 c.f.s. under existing conditions would create backwater sufficient to cause overtopping of the creek banks. The Southern Pacific Company railroad bridge and the El Camino Real highway bridge are adequate to pass flood flows of about 7,000 c.f.s. As previously mentioned, the Bayshore Freeway bridge under existing conditions is limited to a capacity of about 3,500 c.f.s.

FLOOD DAMAGES

45. FLOOD DAMAGE SURVEYS

Surveys were made of damages resulting from the floods of 1940, 1955 and 1958. The data obtained are compiled in Appendix E. Heaviest damages were those of the December 1955 flood and are estimated at $2,304,000 based on October 1959 price levels. The area flooded included approximately 1,200 acres of highly urbanized residential and commercial property and 70 acres of agricultural property. Approximately 700 homes were inundated.

2 sq miles

46. FLOOD DAMAGES

Floods in San Francisquito Creek cause damage by inundation at a discharge of about 3,500 c.f.s. and damage by bank erosion at about

Flooding @ 3500 CFS
Erosion @ 1500 CFS

MICROFILMED
12-1967
PG 12 OF 35

1,500 c.f.s. in the reach above Bayshore Freeway. Prior to 1949, most of the land in these areas was used for agricultural purposes and damages included loss of topsoil by erosion, loss of winter growing crops, loss of hothouse crops due to interruption of heating, and the covering of agricultural land with debris. In recent years, the greater portion of the land subject to inundation damage has been utilized for residential building. Future floods in these areas therefore will cause damage typical of suburban areas, including damages to residences and their contents, landscaped grounds and business establishments.

47. Streets and residential improvements border the stream, and bank erosion occurs more frequently than flooding. The channel for four miles above Newell Road (river mile 2.1), is deep and winding with steep banks; the upper portions of which are easily eroded. During high water stages, the softer overlying soils are carried away by erosion of the banks. This type of damage, largely concentrated at the bends, is particularly serious when improvements are built close to eroding banks. Loss of a small parcel of land may result in the loss of a dwelling as well as detached buildings.

48. The following tabulation summarizes results of the damage surveys of the December 1955 and April 1958 floods and reflects conditions at the time of their occurrence.

	December 1955	April 1958	Standard project
Residential	$ 1,516,000	$ 0	$ 7,161,000
Commercial	125,000	200,000	922,000
Bank erosion	113,000	30,000	236,000
Roads and bridges	32,000	2,500	55,000
Emergency aid	221,000	65,000	341,000
Total	$ 2,007,000	$ 297,500	$ 8,715,000

The estimate of damages for the standard project flood is based on October 1959 conditions of development as discussed in Appendix E.

49. Floods on San Francisquito Creek, although presenting a threat to the safety and welfare of the inhabitants in the flood plain area, are not known to have caused any deaths due to flood flows. No epidemics are known to have been directly attributable to floods.

50. AVERAGE ANNUAL PRIMARY FLOOD DAMAGES

Damages from inundation and from bank erosion were correlated with flood magnitude and, through the relationship between flood magnitude and frequency of occurrence developed in Appendix E, a graphical relationship between flood damages and the frequency of their occurrences was obtained.

From this relationship, based on present conditions of development and October 1959 prices, the average annual primary damage from inundation was estimated at $332,000 and the average annual damage from bank erosion was estimated at $29,000. The estimated average annual damages from inundation and erosion, therefore, total $361,000. Compilation and analysis of the flood-damage data are given in greater detail in Appendix E.

51. AVERAGE ANNUAL DAMAGES UNDER FUTURE DEVELOPMENT

Future damages from inundation and from bank erosion may be expected in direct proportion to the change in economic development in the flood plain. This is discussed in Appendix E of this report. The estimated average annual damages under future conditions of economic development and October 1959 prices are $516,000, of which $475,000 is inundation damage and $41,000 bank erosion. Increase in damages under future conditions is attributed to expected development of vacant and agricultural lands for urban uses.

EXISTING CORPS OF ENGINEERS PROJECTS

52. FLOOD CONTROL PROJECTS

There have been no Congressionally authorized flood control works constructed by the Corps of Engineers along San Francisquito Creek. At the request of local interests, however, Federal funds totaling approximately $200,000 were expended by the Corps of Engineers for emergency channel clearing, levee restoration and emergency bank protective riprap along San Francisquito Creek in 1955 and 1956. Trees threatening to impede flood flows were removed. Weakened and destroyed portions of the levee below Newell Road were restored to their condition before the December 1955 flood. Bank protective works were constructed at several critical locations.

IMPROVEMENTS BY OTHER AGENCIES

53. FEDERAL

There is at this time no Federal project for flood control or for the beneficial use of water in the San Francisquito Creek drainage basin.

54. NON-FEDERAL

The counties of San Mateo and Santa Clara and the cities of Palo Alto and Menlo Park reportedly have expended approximately $345,000, together with $3,500 of W.P.A. funds, on channel clearing, levees, widening and bank protective works, along San Francisquito Creek below El Camino Real to the mouth. Property owners along the creek have tried to protect

$ 345,000 publi
415,000 privat

MICROFILMED
12-1967
PG 1/23 OF 35

their property by installing various types of protection works. These include concrete and timber walls, mats and fills, wire and poles, riprap using rock and scrap material and sacked concrete revetment. These works are valued at about $415,000.

55. Water conservation reservoirs have been constructed in the San Francisquito Creek basin which provide domestic and irrigation water for Stanford University, The Bear Gulch Water Company (Menlo Park) and Palo Alto (in part). The supplemental water supply for Palo Alto comes from the Hetch Hetchy System of the San Francisco Water Department. The water is delivered to Palo Alto under a 20-year contract started in August 1938 and is now being re-negotiated. The contract may be renewed and local interests are assured of present and future use. In addition, a portion of Palo Alto's water comes from 15 wells. The Bear Gulch Water Company delivers domestic water from Bear Gulch reservoir to Menlo Park. Irrigation water for Stanford University comes from Searsville and Felt Lake reservoirs. Lagunita, a recreational lake in the neighboring Matadero Creek basin, is supplied partly with water by diversion from Los Trancos Creek. These conservation reservoirs have little or no effect on flood flows since they are normally full when floods come. Also, flood flows are bypassed due to the undesirable silt load carried by them. Pertinent data relative to the water supply projects in the area are summarized as follows:

Name	Purpose	Capacity (ac-ft)	Cost at time of construction	Year of construction	Owner
Searsville Lake	Irrigation	930	$ 320,000	1890	Stanford University
Felt Lake	Irrigation	1,000	119,000	1930	Stanford University
Lagunita	Recreation	360	14,000	1900	Stanford University
Bear Gulch	Domestic	660	162,000	1896	Bear Gulch Water Company

56. PRIVATE INTERESTS

Individuals and corporations owning lands adjacent to the creek have constructed bank protective works in accordance with plans and use of materials they believed would best alleviate the erosion problem. Although there are instances where these works may be fully effective, the majority of these revetments would not be suitable for inclusion in a flood and erosion control plan.

IMPROVEMENTS DESIRED

57. PUBLIC HEARINGS

The District Engineer held a public hearing in Palo Alto February 17, 1942, in connection with the preliminary examination for San Francisquito Creek. Forty-four persons were in attendence, including representatives of the United States Department of Agriculture and other Federal and State agencies, Stanford University, Palo Alto, San Mateo and Santa Clara Counties and property and business owners. The record of the hearing was transmitted with the preliminary examination report.

58. A second public hearing was held by the District Engineer at San Jose, February 7, 1956 to obtain the latest desires of the local people relative to their flood problems. This hearing was held under the title "Guadalupe River and Adjacent Streams", which included all streams entering San Francisco Bay in Santa Clara County and southern Alameda County. San Francisquito Creek was one of the streams discussed. Changes in conditions since the public hearing of 1942 and the flood of December 1955 created the need for the latter hearing. One hundred and twenty persons attended the hearing, including representatives of the Department of Agriculture (Soil Conservation Service), the California State Division of Highways, the California State Department of Water Resources, San Mateo and Santa Clara Counties, Stanford University, Palo Alto and Menlo Park, and property and business owners within the basin. A record of the hearing is on file in the offices of the reporting and reviewing officials.

59. IMPROVEMENTS DESIRED

Main desires of local interests presented at the first hearing in the form of a prepared report were: prevention of inundation by deepening and widening the channel between University Avenue and the Bayshore Highway; deepening and enlarging the levees along the creek between Bayshore Highway and Mayfield Slough; and prevention of bank erosion by protective works from El Camino Real to the mouth. A request also was made that the San Francisquito floodwater basin be completed and a rock wall constructed along its northern boundary.

60. At the second hearing, local interests presented no definite improvement plans. Data were presented, however, on effects of inundation and bank erosion. Belief was expressed that a solution to the flood problem could be found by construction of channel improvements or by construction of one or more multiple-purpose reservoirs for control of excess flows from headwaters.

MICROFILMED
12-1967
PG 14 OF 35

61. JUSTIFICATION FOR IMPROVEMENT DESIRED

Proponents of channel improvements claimed such works would be justified by benefits resulting from prevention of inundation and erosion damages to urban and suburban properties. Proponents of a multiple-purpose reservoir also included those benefits in their analysis. They indicated additional justification through recharge of ground water acquifers by detaining flood flows in San Francisquito Creek for subsequent controlled release. Additional justification was also expected from benefits resulting from provision of supplemental water for domestic and industrial use. This problem was the subject of continuing study by the California State Department of Water Resources, which led to the publication, in June 1955, of a report prepared by the state engineer for the State Water Resources Board entitled "Santa Clara Valley Investigation", Bulletin No. 7. This bulletin recommended construction of a reservoir on San Francisquito Creek downstream from Searsville Lake for controlling floods and conserving water. Palo Alto engaged an engineering consulting firm which issued a report on 7 August 1952 recommending such a reservoir. Stanford University has regenerated interest in water storage on San Francisquito Creek including feasibility studies of providing additional storage capacity in existing reservoirs. Studies made as recently as 1954 deemed it economically feasible to impound water for irrigation and industrial usages commensurate with the expansion program of the university.

62. LOCAL COOPERATION OFFERED

At the public hearings, local people expressed deep interest in eliminating flooding from San Francisquito Creek. The local people did not offer any specific cooperation at the public hearings. However, subsequently local interests have provided assurances of local cooperation.

FLOOD PROBLEMS AND SOLUTIONS CONSIDERED

63. FLOOD PROBLEMS

Flood problems on San Francisquito Creek are due to inundation and bank erosion. From the creek's source in the hills to the mouth at San Francisco Bay, high velocities of flood flows combined with tortuous channel conditions cause severe erosion damage at bends and at points of softer bank material. Throughout the basin, erosion has uprooted trees growing in the channel and along the banks. This causes or augments debris jams and impedes flood flows. Damaging inundation is confined primarily to the alluvial cone area downstream from University Avenue, river mile 2.6.

64. SOLUTIONS CONSIDERED

Topography and economic development precluded the possibility of effective control of large discharges by diversions or bypass channels. Consideration was given to improvement of the channel by widening and deepening, construction of levees and bank protection works including flood walls, sacked concrete revetment, and concrete lining. The channel capacity could be increased by widening, realigning and deepening; however, this proved to be economically infeasible because of the excessive cost of rights-of-way. Levees in the lower reach in combination with a concrete-lined channel in the upper reaches could provide adequate flood protection. Estimated cost of these works to control the standard project flood would be in excess of $12,000,000 resulting in a benefit-cost ratio of 0.5 to 1. Control of lesser discharges of 5,000 and 7,000 c.f.s. was considered. Using the same combination of flood-control works as was considered for control of the standard project flood, for a 7,000 c.f.s. capacity channel, costs were estimated to be about $8,000,000 resulting in a benefit-to-cost ratio of 0.8 to 1.

65. Studies were made of reservoir storage for various degrees of flood control. These studies proved a high degree of flood protection could be obtained by reservoir storage. Further analyses found that a multiple-purpose reservoir was feasible and could be economically justified. Therefore, the plan of improvement as proposed in this report consists of a multiple-purpose reservoir for flood control and water conservation.

66. Studies of various combination channel works and reservoir, affording the same flood control benefits as the multiple-purpose project, revealed that channel works and reservoir would have a greater flood control cost than reservoir storage. Also, a combined project would be less desirable than the proposed multiple-purpose reservoir because of more interference with existing developments and facilities and the aesthetic value of the creek would be destroyed.

67. RELATED WATER RESOURCES DEVELOPMENT

In the development of plans for flood control, consideration was given to industrial and domestic water supply, recharge of ground water acquifers, irrigation, drainage, abatement of stream pollution, protection of caving streambanks and provision of permanent pools for fish and wildlife conservation and for recreation.

68. The high degree of urban and industrial development attained in San Mateo and northern Santa Clara Counties has been made possible by water supplies imported from other watersheds. This imported water is supplied to the area through the city and county of San Francisco's Hetch Hetchy Aqueduct. The proposed reservoir on San Francisquito Creek would accomplish the dual purpose of reducing flood damages and conserving needed water as desired by local interests.

MICROFILMED
12-1967

PG 15 OF 38

69. DESCRIPTION

The plan of improvement of San Francisquito Creek for flood control consists of a multiple-purpose reservoir for flood control and water conservation with a capacity of 12,600 acre-feet at the spillway crest. The reservoir would be formed by a dam across the creek at river mile 10.2 which is approximately two miles downstream from Searsville Lake. The reservoir would control the runoff from about 28 square miles, or approximately 75 percent of the effective drainage area. To utilize the reservoir area to the maximum for flood control and water conservation, it was necessary to relocate the axis of the dam about 0.3-mile downstream from the location chosen by the State Engineer. An earthfill dam is proposed since a dam of any other type would be more costly. Other factors favoring the earthfill type include the limited bearing capacity of the foundations, earthquake possibilities and availability of suitable materials for earthfills. A general description of the reservoir project is presented in the following paragraphs. More detail is presented in Appendix B, Geology, and Appendix C, Plan of Improvement. Plans are shown in some detail on Plate 3.

70. RESERVOIR AREA

The proposed reservoir site is bounded by gently rolling range land to the north and a steep hill to the south with slopes of about 1-1/4 horizontal to 1 vertical. The maximum justified land acquisition at this site would be about elevation 300 feet above mean sea level. This limitation is imposed by prohibitive cost that would be incurred for more extensive purchase of land and improvements required if a higher dam were constructed. The area northeast of Sand Hill Road, along Bear Creek and Whisky Hill Road, is a densely populated community of rural estates and luxury-type homes, partly within and partly contiguous to the town of Woodside in the unincorporated area of San Mateo County.

71. GEOLOGY AND SOILS, AND CONSTRUCTION MATERIALS

In the reservoir area, the valley floor is comparatively flat and is about 1,000 feet wide. Through this reach the stream flows in a 20-foot deep channel. Dense, moderately indurated, fine grained, Eocene sandstone underlies the right abutment. A fine grained, comparatively compact Miocene sandstone which is easy to erode underlies the valley floor and left abutment. Overburden materials are sandy clay, or silt and clay, derived from residually weathered bedrock from slope wash and from alluvium.

72. Impervious earthfill material suitable for use in the dam embankment is available in the proposed reservoir area within a maximum haul distance of about one mile. Geology, soils, and construction materials are discussed in Appendix B.

73. FEATURES OF THE DAM

The dam would be built to a crest elevation of 302 feet above mean sea level, and rise 100 feet above streambed. It would consist of impervious materials except for a horizontal drainage blanket placed under the downstream portion with connection to a vertical chimney drain downstream from the centerline of the dam. The upstream face would be protected by a layer of riprap over a filter blanket. The downstream face of the dam would be seeded as protection from surface erosion. A drainage trench would be constructed along the downstream toe.

74. FEATURES OF THE SPILLWAY

With the spillway crest and crest of dam elevation established, studies were made of various types and widths of gated and ungated spillways and allied outlet works to provide a required freeboard of five feet. Therefore, the spillway design surcharge would be elevation 297 feet above mean sea level. To meet this limitation, an ungated spillway of the ogee-type with crest at the top of the flood control pool and an ungated flood control outlet through the weir were selected as the least costly.

75. The spillway would be located near the left abutment with a crest at elevation 289 feet above mean sea level and would vary in width from about 300 feet at the approach channel entrance to 220 feet at the weir. The flood control outlet would consist of a 9-foot wide by 9-foot high ungated conduit through the weir to be used for flood-control operation of the reservoir. The spillway would have the capacity to pass the spillway design flood of 20,300 cubic feet per second with the water surface at elevation 297 feet above mean sea level. The flood control outlet would discharge 2,300 cubic feet per second and the weir 18,000 cubic feet per second. The spillway chute would lead to a flip-bucket for dissipating excess energy and result in prevention of scouring velocities in the creek channel immediately below the structure. Since the streambed is in rock in this reach and for a distance downstream, water released from the reservoir is expected to have little or no effect on streambed degradation.

76. FEATURES OF THE OUTLET WORKS

The outlet works, used to release moderate flows for water conservation and flood control as required, would be near the left dam abutment. These works would consist of a 4-foot diameter gated conduit having a capacity of about 400 c.f.s. with the water surface at the top of the conservation pool. The flow through the conduit would be controlled at the

MICROFILMED
12-1967
PG 16 OF 35

downstream end by either a gate or needle valve. Two upstream horizontal hydraulically operated emergency closure gates from the top of the dam would provide the means of repair and maintenance work. This type of outlet work has been successfully used by the Santa Clara County Flood Control and Water Conservation District.

77. DISTRIBUTION OF RESERVOIR CAPACITY TO PROJECT PURPOSES

The San Francisquito Creek reservoir as herein considered would have a gross storage capacity of 12,600 acre-feet which would be apportioned as follows:

Flood control	8,500	acre-feet
Water conservation	3,500	" "
Siltation	600	" "
Total	12,600	acre-feet

78. Allocation of 8,500 acre-feet of storage capacity to flood control would provide an economically justified protection against flood damage. The adopted flood control storage is adequate to control all floods of record although insufficient to control fully the standard project flood. The proposed storage allocation to flood control will provide a high degree of protection to the highly developed flood plain.

79. The 3,500 acre-feet for water conservation was selected as the result of detailed studies and was found to be an amount that would meet with the approval of local interests and can be economically justified. This allocation also provides maximum benefits with maximum utilization of the reservoir area. The reservation for siltation was determined after a review of available data and computations based on one season's suspended sediment measurements and seven years of streamflow records.

80. DEGREE OF FLOOD PROTECTION PROVIDED

Protection against the standard project flood was found to economically unjustified. From an analysis of the effect of providing various amounts of flood-control storage, the conclusion was reached that 8,500 acre-feet of flood-control storage would provide an acceptable degree of control within the range of economic justification. A flood of the magnitude of the 1955 flood would be reduced from a peak of 5,560 c.f.s. (at the Stanford University gaging station) to 2,000 c.f.s. Floods of greater magnitude would be reduced by larger amounts.

81. RELOCATION OF UTILITIES

With the dam constructed to elevation 302 feet above mean sea level, cost for relocation would be held to a minimum. To preclude relocation of Sand Hill Road, auxiliary dikes would be constructed along Sand Hill Road to the same elevation as the crest of the proposed dam where the road is presently below the proposed dam crest elevation. Relocation of utilities within the reservoir area would be required for about 0.3-mile of electric power line and about 2.5 miles of 12-inch diameter cast-iron pipeline extending from Searsville Lake to Stanford University. Local runoff from areas landward of the auxiliary dikes and Sand Hill Road would be drained by gravity flow. Culverts now emptying into the reservoir area would be retained and outlets provided either collectively or individually.

82. Part of the county road (Whisky Hill Road) along the upper left side and the secondary road along the right upper side of the proposed reservoir may require relocation. It is probable that future highway and road development may preclude relocation of Whisky Hill Road. In addition to possible improvement of existing roads, the State Highway Commission during its July 1958 meeting approved the general route of the Junipero Serra Freeway, State Highway Route 239, a part of the proposed Federal interstate highway system. The approved route, which is the approximate location of the freeway, crosses the reservoir area as indicated on Plate 2 to this report. The freeway will not adversely affect proposed reservoir storage nor add to the cost of the proposed reservoir project. Neither will the reservoir project have any significant effect on the cost of the freeway project. The State Division of Highways and the Corps of Engineers have cooperated in the planning for this route and project plans for the freeway will provide mutually acceptable features. Construction of this freeway is being considered by the State to be five to ten years in the future. However, based on conditions at this time, the cost of road relocations is contained in the estimated costs of the project. These relocations would consist of approximately 0.3-mile of 2-lane surfaced highway and 0.5-mile of 2-lane surfaced road indicated on Plate 2 of this report.

83. METHOD OF RESERVOIR REGULATION

The proposed reservoir is designed to operate unattended with automatic releases of flood flows through an ungated conduit in the spillway section. The conduit is designed to pass 2,000 c.f.s. when the flood control pool is full. For the design flood, the discharge from the reservoir combined with the downstream tributary flows would not exceed 3,000 c.f.s., the desirable safe non-damaging discharge in view of the limited channel capacity of 3,500 c.f.s. This affects an overall reduction in flood peaks and flood damages downstream from the dam. If desired, additional flows could be released through the water conservation outlet works since its capacity would be 500 c.f.s. at the top of the flood control pool. Reservoir regulation is discussed in Appendix A.

MICROFILMED
12-1967
PG 17 OF 35

84. General procedures have been adopted for reservoir regulations which make best use of the available flood control storage and meet the objectives of flood and damage reductions. The reduction in flood peaks is indicated by the following tabulation:

Discharge downstream of Los Trancos Creek

	Present conditions (c.f.s.)	Project conditions (c.f.s.)	Reduction (c.f.s.)
December	5,560	2,000	3,600
Reservoir design flood	9,400	3,000	6,400
Standard project flood	13,800	6,500	7,300
Probable maximum flood	27,000*	20,300*	6,700*

*At damsite

Reservoir regulation is discussed in Appendix A.

MULTIPLE-PURPOSE FEATURES

85. WATER CONSERVATION

Under the plan herein considered, the proposed 3,500 acre-feet of storage capacity for water conservation would provide an average annual firm yield of approximately 1,500 acre-feet. The total annual yield would be utilized for domestic and industrial uses. Local interests would make releases commensurate with their requirements.

86. RECREATION AND FISH AND WILDLIFE

The limited storage which can be developed economically in the reservoir precludes establishment of a minimum pool for recreational and fish and wildlife purposes. However, the California Department of Fish and Game believes that the reservoir has potentiality for management as a combined warm-water fishing lake and recreational area. The United States Fish and Wildlife Service concurs. Since the local interests would operate and maintain the proposed reservoir the provisions for fish life would be their responsibility. The comments of the Fish and Wildlife Service are presented in Appendix F.

87. The San Francisquito Creek project would be located in an area where public aquatic recreational activities are now limited. The National Park Service in evaluating the recreational potential found that if basic public use facilities were made available for recreational purposes, the San Francisquito Creek reservoirs would have a recreational potential. Based on these findings and in the public's interest this report considers the provisions of basic public use facilities for recreation as a Federal responsibility within the authority of the 1946 Flood Control Act.

These facilities would be an integral part of the reservoir subordinate to the project purposes and resulting in collateral use. The public use facilities considered are access and circulation roads, parking areas, picnic areas, aquatic areas, potable water, sanitation facilities, trails, walks, signs and markers and conservation landscaping as described in Appendix F, by letter of 12 September 1961 from the National Park Service Exhibit "A".

ESTIMATE OF FIRST COST AND ANNUAL CHARGES

88. FIRST COST

The estimated first cost of the proposed reservoir project is based on prices prevailing in November 1959. As conceived herein the land and construction costs for the basic public use facilities would be a Federal cost. As described later in this report local interests are to contribute in cash prior to start of construction for the cost of lands, easements, rights-of-way and relocations allocated to flood control, and are to repay the Federal government for the cost allocated to water conservation in fifty equal annual installments. The distribution of first costs between the Federal government and local interests on the basis of the foregoing is given in the following tabulation:

MICROFILMED
12-1967
PG 18 OF 35

Federal cost

Lands and damages	$ 2,570,000	
Dam and Reservoir	4,929,000	
Relocations of roads and utilities	255,000	
Basic public use facilities		
Lands	285,000	
Construction	350,000	
Preauthorization surveys	76,000	
Gross cost	$ 8,465,000	
Less non-Federal cash contribution for lands and damages and relocations allocated to flood control	2,354,000	
Difference	$ 6,111,000	
Less preauthorization surveys	76,000	
Required Federal appropriation		$ 6,035,000
Less non-Federal cost allocated to water conservation		1,288,000
Net Federal first cost		$ 4,747,000

Non-Federal cost

Cash contribution for lands and damages and relocation costs allocated to flood control	$ 2,354,000	
Repayment over a 50-year period of costs allocated to water conservation	1,288,000	
Total non-Federal cost		$ 3,642,000
Total project first cost		$ 8,389,000
Preauthorization surveys		76,000
Total project cost		$ 8,465,000

89. ANNUAL CHARGES

Annual charges are based on a 50-year economic life of the project and a Federal interest rate of 2-5/8 percent, and a non-Federal interest rate of 4 percent. Annual charges amount to an estimated $437,000 including $51,000 for maintenance and operation and major replacements.

Of the total, $308,000 is allocated to flood control and $72,000 to water conservation. The derivation of these values is given in Appendix C, and a summary is presented below:

Item	Flood control	Water conservation	Total
Federal			
Interest plus amortization			
Construction	$153,000	None	$153,000
Preauthorized surveys	2,000	$ 1,000	3,000
Total Federal	$155,000	$ 1,000	$156,000
Non-Federal			
Interest plus amortization	$134,000	$67,000	$201,000
Maintenance and operation (including replacements)	19,000	4,000	23,000
Total non-Federal	$153,000	$71,000	$224,000
Total project	$308,000	$72,000	$380,000

ESTIMATE OF BENEFITS

90. TYPES OF BENEFITS

Construction of a reservoir on San Francisquito Creek would result in benefits arising from: (1) flood control by the reduction of both inundation and bank erosion damages; and (2) water conservation by providing additional water for supplementing existing supplies for urban use.

91. FLOOD CONTROL BENEFITS

The 8,500 acre-feet of flood control storage in the proposed multiple-purpose reservoir in San Francisquito Creek would result in important flood control benefits through reduction in peak flows, and corresponding reduction in inundation and bank erosion damages. It is estimated that average annual damages would be decreased nearly 95 percent. Other benefits from the operation of the reservoir for flood control would be reduction in annual maintenance costs of providing protection against bank erosion.

MICROFILMED
12-1967
PG 19 OF 35

92. The reservoir would control the runoff from about 28 square miles, or approximately 75 percent of the 38.4 square-mile effective drainage area. The area upstream from the damsite includes a portion of the drainage basin receiving the greatest rainfall. The percentage of runoff controlled would be greater than the percentage of the area above the site. The future average annual damages from inundation of areas downstream from the reservoir site are estimated to be $475,000. As developed in Appendix E, the project would reduce these damages to $29,000 with a resulting average annual benefit of $446,000.

93. The value of land lost by bank erosion below the site of the reservoir was estimated earlier in this report at $41,000 per year. By reducing the peak flow and giving consideration to recently constructed local bank protective works,it is estimated (see Appendix E) that reservoir operations would result in an average annual benefit of $36,000.

94. The replacement value of all existing bank-protective works is estimated at $415,000. The average annual cost of maintenance of these works is estimated to be $21,000. Under project conditions, it is estimated that this would be reduced by approximately 93 percent, resulting in an annual benefit of $20,000. This is discussed in Appendix E.

95. BENEFITS FROM HIGHER LAND UTILIZATION

The flood plain is a highly developed urbanized area. Much land in the flood plain available for development was turned into residential areas subsequent to the 1955 flood. There was some land value loss immediately following floods in the Palo Alto area. However, the demand for land in this area resulted in a quick value recovery. Therefore, no increase in values is considered within the flood plain because these lands are currently being developed to the ultimate.

96. INTANGIBLE FLOOD CONTROL BENEFITS

Intangible flood control benefits resulting from the proposed reservoir are considered minor. Although no deaths have been reported from past floods, considerable anxiety is felt by residents in the flood plain because of the uncontrolled flood flows.

97. SUMMARY OF AVERAGE ANNUAL FLOOD CONTROL BENEFITS

Benefits resulting from a reduction in inundation damages are estimated to be $446,000, from reduction in bank erosion damages $36,000, and from reduction in channel works damages $20,000. This makes a total flood control benefit of $502,000.

98. WATER CONSERVATION BENEFITS

The area trend toward further urban and suburban development has been intensified during the past few years and is expected to continue. Area development with increased population will require a substantially greater water supply. The 3,500 acre-feet of storage allocated for water conservation use would provide an estimated average annual yield of 1,500 acre-feet. To evaluate prospective water conservation benefits, an estimate was made of the benefits to result from supplying 1,500 acre-feet annually for urban use in the vicinity of Palo Alto. The city of Palo Alto obtains its water supply by pumping from fully utilized, city-owned wells. Supplemental water is purchased from the San Francisco Water Department's Hetch Hetchy pipeline at a cost of $70 per acre-foot. The cost of treating and conveying water from the proposed reservoir on San Francisquito Creek has been estimated at $17 per acre-foot. This would leave a net value for water at the reservoir of $53 per acre-foot. This value is used as the basis for evaluating the water conservation feature. The supplying of 1,500 acre-feet of firm conservation water annually would result in an estimated average annual benefit of $79,500. This is the estimated net benefit after deducting all anticipated costs except those for reservoir construction. Studies of providing water by reservoirs in the basin for single-purpose conservation use revealed that it would cost in excess of $125 per acre-foot or nearly twice as much as by using the Hetch Hetchy source. Details of the water resources of the basin are presented in Appendix D. A comparison of prospective benefits for water conservation and the estimates of cost indicates that water conservation storage in the proposed multiple-purpose reservoir is justified.

99. RECREATIONAL BENEFITS

Under the proposed project concept, the benefits that might be derived from the public use recreational facilities are considered to be collateral to the primary project purposes. Benefits estimated by the National Park Service are $160,000. The derivation of these benefits is presented in Appendix "F".

100. SUMMARY OF EVALUATED BENEFITS

Benefits from the proposed multiple-purpose reservoir project for the primary project purposes as evaluated herein amount to $502,000 from reduction in flood damages and $79,500 from water conservation for a total of $581,500. Recreational benefits amount to $160,000 for a combined total of $741,500.

MICROFILMED
12-1967
PG 20 OF 35

101. COMPARISON OF BENEFITS AND COSTS

The overall primary economic aspects of the proposed project are indicated by the estimated benefits of $581,500 as compared with annual charges of $380,000. The resulting benefit-to-cost ratio is 1.5 to 1. The benefit-to-cost ratio is 1.6 to 1 for flood control and 1.1 to 1 for water conservation as shown below:

Item	Flood control	Water conservation	Total
Average annual benefits	$ 502,000	$ 79,500	$ 581,500
Annual charges	308,000	72,000	380,000
Benefit-to-cost ratio	1.6	1.1	1.5

LOCAL COOPERATION

102. FACTORS GOVERNING REQUIRED COOPERATION

This report considers that the proposed reservoir project on San Francisquito Creek would be constructed by the Federal government. All costs allocated to water conservation are required to be reimbursed to the Federal government. Local interests have indicated that they intend to make repayment with interest, in fifty annual installments in accordance with the Water Supply Act of 1958.

103. With regard to the flood-control features of the reservoir, it is recognized that benefits would accrue to a relatively confined local area and that this method of effecting flood control is in lieu of channel improvements and levees. Therefore, the requirements of local cooperation as prescribed in flood control acts for local protection works would apply. Local interests would be required to furnish all lands, easements and rights-of-way and relocate roads, utilities and other structures.

104. REQUIRED LOCAL COOPERATION

From consideration of the aforementioned conditions and in keeping with established policies and authorities relative to requirements of cooperation, local interests will be required to give assurances satisfactory to the Secretary of the Army that they will:

a. Contribute in cash, prior to the start of construction of the project, funds equivalent to that portion of the cost of lands, easements, rights-of-way and relocations allocated to flood control, being 75.7 percent of the total cost of those items now estimated at $2,354,000.

b. Repay to the United States Treasury 15.3 percent of the total project cost now estimated at $1,288,000, plus interest during construction, in not more than 50 installments, with interest at a rate established at the time of construction by the Secretary of the Treasury, in consideration of the water-conservation benefits.

c. Maintain and operate the project with operations for flood control to be in accordance with regulations prescribed by the Secretary of the Army.

d. Hold and save the United States free from damages due to the construction works.

e. Satisfy all claims concerning water rights arising from the construction, maintenance and operation of the improvements.

f. Enter into an agreement among themselves as to the method of regulation of water conservation subject to flood-control priority.

g. Prevent any encroachment on the stream channel downstream from the dam to the mouth which would interfere with the proper functioning of the improvements or lessen their beneficial effects, or reduce the flood carrying capacity existing in 1960, or, in any event, to less than 3,500 c.f.s.

ALLOCATION OF COSTS

105. ALLOCATION OF COSTS AMONG PURPOSES

Cost of constructing the proposed reservoir on San Francisquito Creek has been allocated, exclusive of the costs of recreational facilities and preauthorization studies, to the two primary purposes which the reservoir would serve, namely, flood control and water conservation. The "Use of Facilities Method" described in EM 1160-2-101 was the basis for allocation of costs. The relative storages were used as the basis for allocating costs remaining to be distributed. The allocation is given in Appendix C. Application of this method results in allocating 83.4 percent of the first cost (exclusive of recreational costs), or $6,466,000, and 81 percent of annual maintenance and operation, or $19,000 to flood control, and the remaining $1,288,000 and $4,000, respectively, to water conservation.

106. APPORTIONMENT OF COSTS AMONG INTERESTS

As discussed under Required Local Cooperation, local interests would be required to provide for all costs of lands, easements, rights-of-way and relocations allocated to flood control the same as for local protection works. Also, they would operate and maintain the completed works. In addition, costs chargeable to water conservation for urban and industrial uses were assigned to local interests. Accordingly, the estimated Federal cost, therefore, is $4,747,000 for new construction exclusive of $76,000 for preauthorization studies, and the estimated non-Federal cost is $3,642,000 for new construction and $51,000 annually for maintenance and operation.

MICROFILMED
12-1967
PG 21 OF 35

107. METHOD OF FINANCING FIRST COSTS

Local interests would be required to furnish all lands, easements, rights-of-way and relocations allocated to flood control as prescribed in flood control acts for local protection works and repay that part of the project cost allocated to water conservation. A large part of the costs allocated to water supply represents land and relocation costs. Because local interests wish to repay the costs allocated to water conservation by annual payments in accordance with the Water Supply Act of 1958 this would permit a part of the lands and relocation costs to be financed initially by the Federal government. Local interests would contribute to the Federal government prior to the initiation of construction the portion of the costs allocated to the flood-control function. All construction including land acquisition and relocations would be accomplished by the Federal government. Title to all lands would be transferred to the local interests upon completion and acceptance of the project. In accordance with the foregoing local interests would be required to contribute in cash prior to the start of construction of the project 75.7 percent of the cost for lands, easements, rights-of-way and relocations required for the project, estimated to be $2,354,000, which is the portion of such costs allocated to the flood-control function. Federal appropriations required for construction of the project are $6,035,000 as indicated below:

Federal cost:

Total project cost (excluding preauthorization surveys)	$ 8,389,000
Less non-Federal cash contribution	2,354,000
Required Federal appropriation	$ 6,035,000

Local interests would be required to repay 15.3 percent of the presently estimated $8,389,000 total project cost, plus interest during construction at a rate to be established at the time of construction by the Secretary of the Treasury in consideration of the water-supply benefits.

108. COORDINATION WITH OTHER FEDERAL AGENCIES

After preliminary studies indicated probable economic feasibility of a multiple-purpose reservoir project, preliminary plans were discussed with regional representatives of interested Federal agencies. Comments from the agencies are presented in Appendix F. The agencies are as follows:

U.S. Atomic Energy Commission
U.S. Fish and Wildlife Service
U.S. National Park Service
U.S. Bureau of Public Roads
U.S. Public Health Service
U.S. Bureau of Reclamation
U.S. Department of Agriculture, Soil Conservation Service

109. The U.S. Atomic Energy Commission indicates a definite interest in the proposed reservoir project in view of the fact that a proposed linear accelerator is sited in the same general area. Discussions with representatives of the Atomic Energy Commission indicate that the two facilities can be constructed to be compatible with each other. Also discussed was the possibility of the reservoir providing a source of water for the atomic facility. Coordination will continue toward full compatible utilization of the area for the proposed facilities.

110. The U.S. Fish and Wildlife Service recommends that "The Corps of Engineers cooperate with the California Department of Fish and Game in formulating plans for fish life management; and that lands required for the reservoir be acquired in fee insofar as possible to assure the highest public use of the proposed reservoir for fishing and other types of recreation."

111. The National Park Service report, presented in Appendix F, concludes that the provision of basic public use recreational facilities at Federal expense at the proposed San Francisquito Creek reservoir would have a recreational potential in the long-range public interest.

112. The U.S. Bureau of Public Roads states that two county roads, Sand Hill and Whisky Hill, are a part of the Federal-Aid Secondary System and could be affected by the proposed reservoir. It also states that the proposed Interstate and Defense Highway Route 91, Junipero Serra, would cross the reservoir area. These problems have been resolved with the interested local agencies to provide for a compatible plan of development. The above mentioned roads are shown on Plate 2.

113. The U.S. Public Health Service indicates a definite interest in the proposed reservoir project since the storage of water will affect public health, welfare, and safety. The comments of the State and County Health Departments, the California Bureau of Vector Control and its Communicable Disease Center are included in the comments by the U.S. Public Health Service.

114. The U.S. Bureau of Reclamation states that the proposed reservoir would not affect any of its existing or proposed developments.

MICROFILMED
12-1967

115. The Department of Agriculture states that the area is rapidly growing toward urbanization and, therefore, is outside the scope of interest of the Soil Conservation Service.

116. COORDINATION WITH THE STATE OF CALIFORNIA

The State of California, Department of Water Resources indicates, in its comments presented in Appendix F, the possibility that the South Bay Aqueduct System may, when costs are developed for the project, be a competitive source of water supply. The State Department of Water Resources concurs in the need for flood control aspects of the proposed project.

117. COORDINATION WITH LOCAL INTERESTS

Development of the plan of improvement proposed in this report has been accomplished by close coordination with local interests. At a general meeting with local interests, the plan of improvement was discussed, including project features, approximate costs and requirements of cooperation.

118. Supervisors for San Mateo and Santa Clara Counties have indicated by resolution their agreement to the proposed plan of improvement. Each county either jointly or singly has indicated its willingness to fulfill the requirements of local cooperation. Each county has the ability to meet its requirements. Local assurances are conditional upon the passage of proposed legislation by the State of California to authorize reimbursement by the State of costs for lands, easements, and rights-of-way allocated to flood control.

119. REVIEW BY OTHER AGENCIES

Copies of the report were submitted to the regional offices of various interested local Federal agencies, the State of California, and local interests of San Mateo and Santa Clara Counties for review. Their replies are included in Appendix F to this report. None of the agencies opposed the recommended improvements. A discussion of the comments of other agencies is contained in Appendix F.

DISCUSSION

120. Studies and investigations reveal that a flood problem exists along San Francisquito Creek and unless protective measures are taken, future floods will cause recurrent damages. Also, it was found that a need exists for additional development of local water supplies as a result of increased urbanization.

121. In connection with these studies, methods of providing adequate protection for developments in the flood plain by channel improvements were found to be economically unjustified. The excessive cost of these works is due in a large measure to the expensive rights-of-way required through the highly urbanized area. The extensive modifications required of numerous bridges now spanning San Francisquito Creek also are factors contributing to the high cost for improving the channel.

122. Studies were made of various sites and capacities of single- and multiple-purpose reservoirs for flood control and water conservation. Studies also were made of channel works and reservoir affording the same benefits as a single-purpose flood-control reservoir. From these studies it was found that the proposed multiple-purpose reservoir for flood control and water conservation was the most feasible plan of improvement. With a dam crest at elevation 302, the reservoir would have a gross storage capacity of 12,600 acre-feet. Of this, 8,500 acre-feet would be reserved for flood control, 3,500 acre-feet for water conservation and 600 acre-feet for siltation. The site for the proposed dam is at river mile 10.2. A reservoir at the site would control the runoff from 28 square miles or about 75 percent of the 38.4-square mile effective drainage area and about 85 percent of the runoff. Control of all major stream inflow except Los Trancos Creek which has a drainage area of 8 square miles would be accomplished. Providing complete protection against the standard project flood was found to be economically infeasible. However, by the construction of the proposed reservoir, a high degree of flood protection will be obtained. Estimates indicate that nearly 95 percent of the overall annual damages would be eliminated. The design flood is equal to 68 percent of the standard project flood.

123. The first cost of the proposed project exclusive of recreational costs is estimated at $7,830,000, which includes $76,000 for the cost of preauthorization studies. The corresponding annual charge would be $380,000 which includes $23,000 for maintenance and operation and for major replacement. The first cost of providing basic public use recreational facilities is estimated at $635,000. The corresponding annual charge would be $57,000 which includes $28,000 for maintenance and operation and for major replacements.

124. The reservoir would provide annual primary benefits estimated at $581,500 with a benefit-to-cost ratio of 1.5 to 1.0. The distribution of annual costs and benefits for the primary project purposes (flood control and water conservation) is as follows:

MICROFILMED
12-1967
PG 23 OF 35

	Flood Control	Water Conservation	Total
Federal:			
Interest plus amortization	$ 155,000	$ 1,000	$ 156,000
Non-Federal:			
Interest plus amortization	134,000	67,000	201,000
Maintenance, operation and replacements	19,000	4,000	23,000
Total, allocated annual charges	$ 308,000	$ 72,000	$ 380,000
Annual benefits	$ 502,000	$ 79,500	$ 581,500
Benefit-to-cost ratio	1.6	1.1	1.5

125. As herein considered, the Federal government would perform all construction including relocations and purchase all lands, easements and rights-of-way required for the San Francisquito Creek flood control and water conservation reservoir. The title to all acquired land except the 57 acres required for the public use facilities would be transferred to the local interests upon completion and acceptance of the project. The local interests would repay to the U.S. Treasury, with interest, all costs allocated to the water supply function, in equal annual installments over a period of not to exceed 50 years. In addition, they would contribute in cash prior to the start of construction of the project, funds equivalent to that portion of the cost of lands, easements, rights-of-way, and relocations allocated to flood control. This cash contribution, which would be 75.7 percent of the total cost of those items, is now estimated at $2,354,000. The required Federal appropriation is $6,035,000, or $8,389,000 less $2,354,000. Local interests would maintain and operate the project giving priority to flood control in accordance with rules and regulations to be prescribed by the Secretary of the Army.

126. In view of the comments by the State of California's Department of Water Resources, it is considered appropriate that a reexamination of the economic justification of the conservation feature be made at the design stage. The reexamination would give consideration to the South Bay Aqueduct of the State's Water Plan and other alternate sources for which costs may have been developed at that time. In accordance with the views and resolutions of local interests, expressing their desires, the conservation feature is included in the proposed project.

127. Additional information on recommended and alternative projects called for by Senate Resolution 148, 85th Congress, 1st Session, adopted January 28, 1958, is contained in Attachment 1 to this report.

CONCLUSIONS

128. The District Engineer finds that:

a. A flood problem exists along San Francisquito Creek and unless protective measures are taken, recurrent damages will be sustained.

b. A need exists for the development of local sources of water supply to supplement existing sources for urban and industrial uses in the vicinity.

c. Provision for flood protection by construction of channel improvements is not economically justified.

d. A multiple-purpose reservoir with a total capacity of 12,600 acre-feet for flood control and collateral public use recreational facilities, and water conservation purposes on San Francisquito Creek is economically justified.

e. The prospective average annual/primary purpose ~~benefits~~ from construction of the proposed San Francisquito Creek reservoir would be $502,000 for flood control and $79,500 for water conservation, for a total of $581,500, which compared with average annual costs of $380,000 gives a benefit-to-cost ratio of 1.5 to 1.0.

f. The estimated construction first cost for the San Francisquito Creek reservoir, excluding preauthorization study cost, is Federal $4,747,000 and non-Federal $3,642,000 of which $2,354,000 is for lands, easements, rights-of-way and relocations allocated to the flood-control function and $1,288,000 for the water-supply function which local interests will repay under the Water Supply Act of 1958. Therefore, Federal appropriations required for construction are now estimated as $4,747,000 plus $1,288,000 or $6,035,000.

g. The proposed reservoir should be maintained and operated by local interests at their own expense with operations for flood control being in accordance with regulations prescribed by the Secretary of the Army.

h. The non-Federal cost of the water-supply function would be repaid to the United States Treasury by annual payments in accordance with the provisions of the Water Supply Act of 1958.

RECOMMENDATIONS

129. The District Engineer recommends:

a. Adoption by the United States of a project for flood control and allied purposes including the provision of basic public use recreational facilities at Federal expense in the drainage basin of San Francisquito Creek, California, consisting of a multiple-purpose reservoir for flood control

MICROFILMED
12-1967

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and water conservation having a gross storage capacity of 12,600 acre-feet and at an estimated Federal cost of $5,400,000 exclusive of preauthorization study costs.

b. That construction of the reservoir recommended above be subject to such reasonable modifications as, in the discretion of the Chief of Engineers, may be advisable at the time of construction, and subject also to the condition that local interests agree to operate and maintain the recreational facilities together with assurances satisfactory to the Secretary of the Army that they will:

(1) Contribute in cash, prior to the start of construction of the project, funds equivalent to that portion of the cost of lands, easements, rights-of-way and relocations allocated to flood control, this amount being 83.4 percent of the total cost of those items now estimated at $2,354,000.

(2) Repay to the United States Treasury 16.6 percent of the total project cost, now estimated at $1,288,000, plus interest during construction, in not more than 50 installments with interest at the rate established at the time of construction by the Secretary of the Treasury, in consideration of the water conservation benefits.

(3) Maintain and operate the project with operations for flood control to be in accordance with regulations prescribed by the Secretary of the Army.

(4) Hold and save the United States free from damages due to the construction works.

(5) Satisfy all claims concerning water rights arising from the construction, maintenance and operation of the improvements.

(6) Enter into an agreement among themselves as to the method of regulation for water conservation subject to flood control priority.

(7) Prevent any encroachment on the stream channel downstream from the dam to the mouth which would interfere with the proper functioning of the improvements or lessen their beneficial effects, or reduce the flood carrying capacity existing in 1960, or, in any event, to less than 3,500 c.f.s.

JOHN A. MORRISON
Colonel, Corps of Engineers
District Engineer

SPDGP (Jan 61) 1st Ind
SUBJECT: Report of Survey on San Francisquito Creek, San Mateo and Santa Clara Counties, California, for Flood Control and Allied Purposes

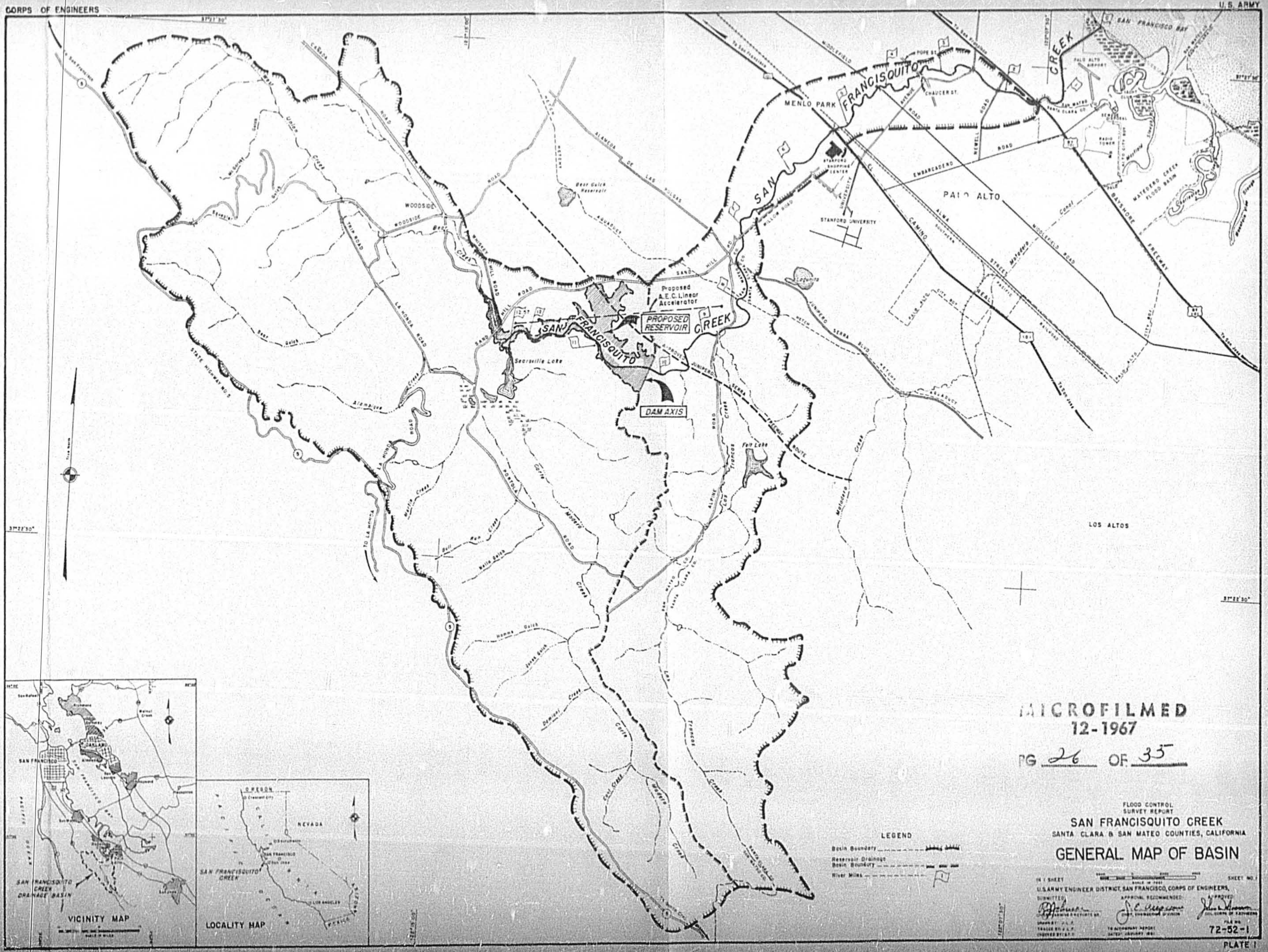
U S Army Engr Div, South Pacific, San Francisco, Calif 24 April 1961

TO: Chief of Engineers, DA, Washington, D. C.

I concur in the conclusions and recommendations of the District Engineer.

MacDonnell
R. G. MacDONNELL
Brigadier General, USA
Division Engineer

MICROFILMED
12-1967
PG 25 OF 35



MICROFILMED
12-1967
PG 26 OF 35

LEGEND

Basin Boundary
Reservoir Drainage Basin Boundary
River Miles

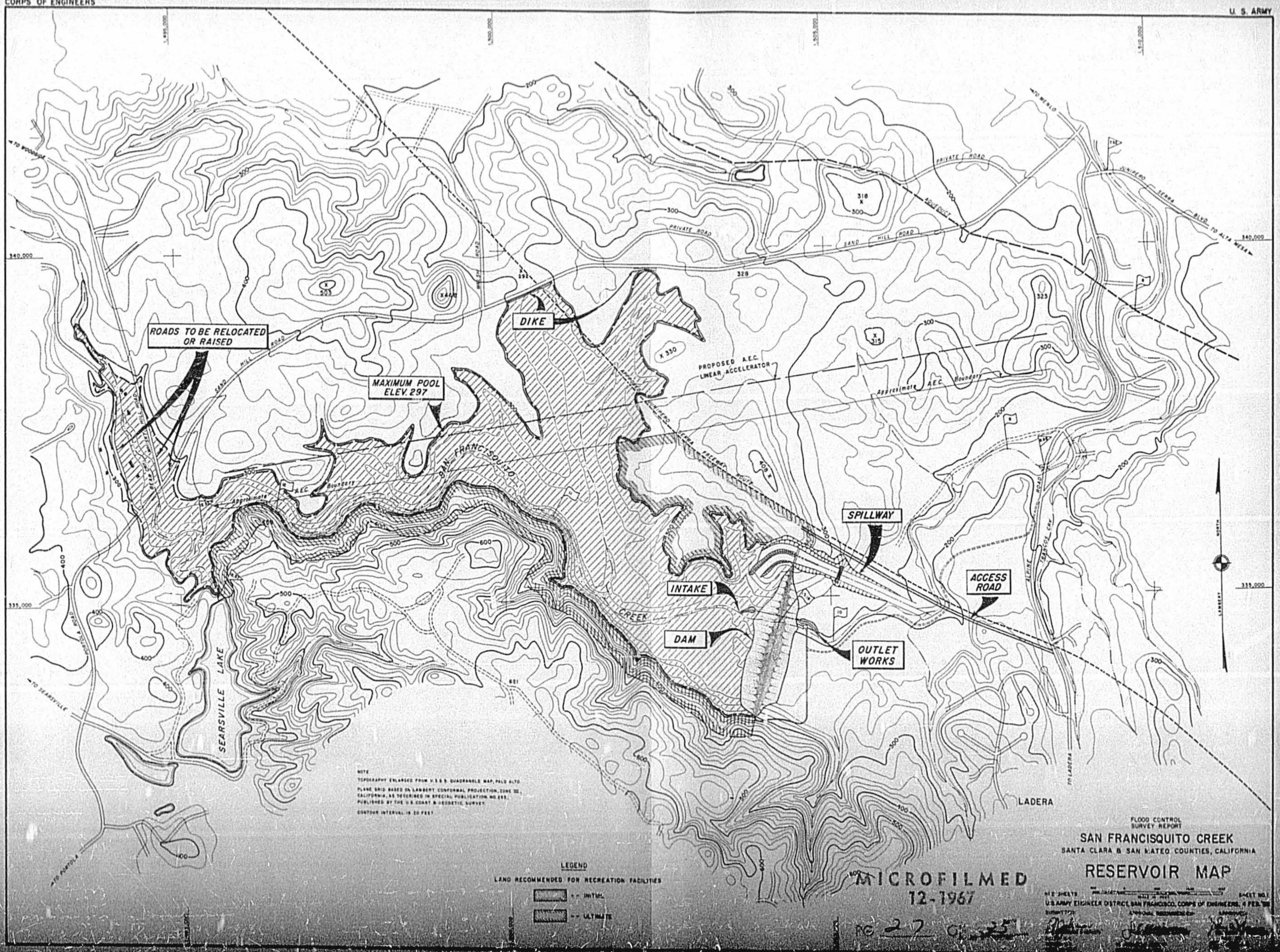
FLOOD CONTROL
SURVEY REPORT
SAN FRANCISQUITO CREEK
SANTA CLARA & SAN MATEO COUNTIES, CALIFORNIA

GENERAL MAP OF BASIN

IN 1 SHEET
SCALE IN FEET
SHEET NO. 1
U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS.
SUBMITTED:
APPROVAL RECOMMENDED:
APPROVED:
R. Johnson
J. C. Bergeson
John Moonan
COL. CORPS OF ENGINEERS
TO ACCOMPANY REPORT
FILE NO.
72-52-1
PLATE 1

CORPS OF ENGINEERS

U. S. ARMY



NOTE

TOPOGRAPHY ENLARGED FROM U.S.G.S. QUADRANGLE MAP, PALO ALTO

PLANE GRID BASED ON LAMBERT CONFORMAL PROJECTION, ZONE III, CALIFORNIA, AS DESCRIBED IN SPECIAL PUBLICATION NO. 253, PUBLISHED BY THE U.S. COAST & GEODETIC SURVEY.

CONTOUR INTERVAL IS 20 FEET

LEGEND

LAND RECOMMENDED FOR RECREATION FACILITIES

▨ - - INITIAL

▨ - - ULTIMATE

FLOOD CONTROL
SURVEY REPORT

SAN FRANCISQUITO CREEK

SANTA CLARA & SAN MATEO COUNTIES, CALIFORNIA

RESERVOIR MAP

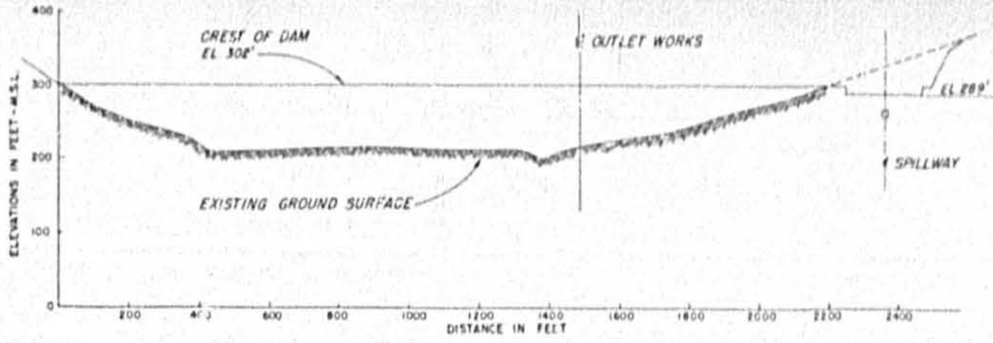
SHEET NO. 1

U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS, 4 FEB.

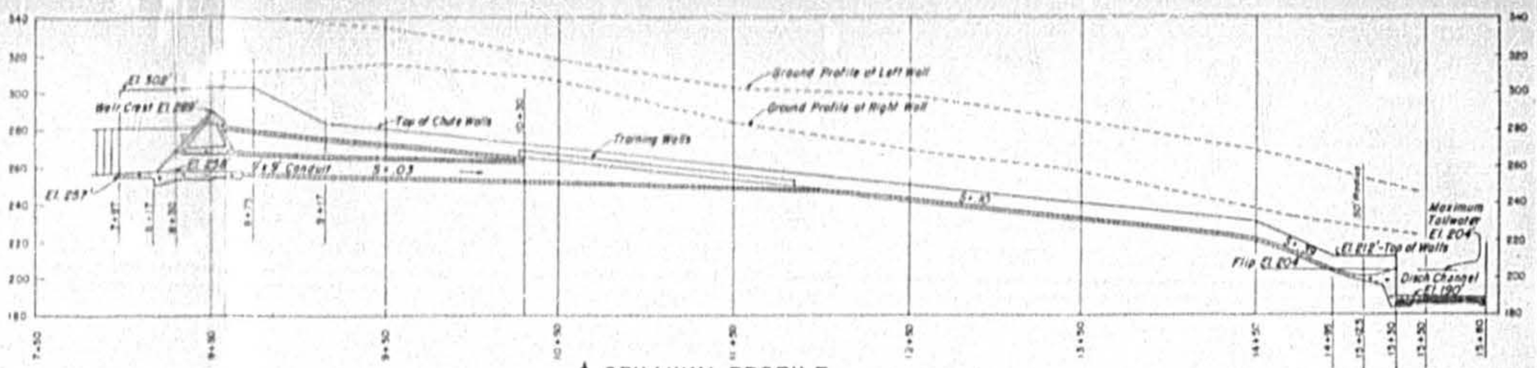
SUBMITTED: APPROVAL RECOMMENDED: APPROVED:

MICROFILMED
12-1967

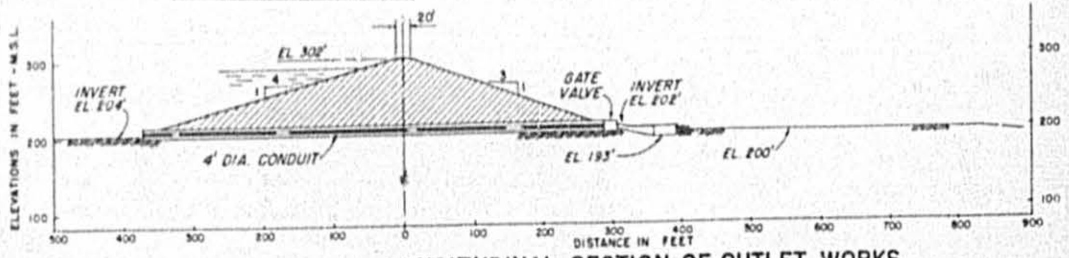
PG 27 OF 35



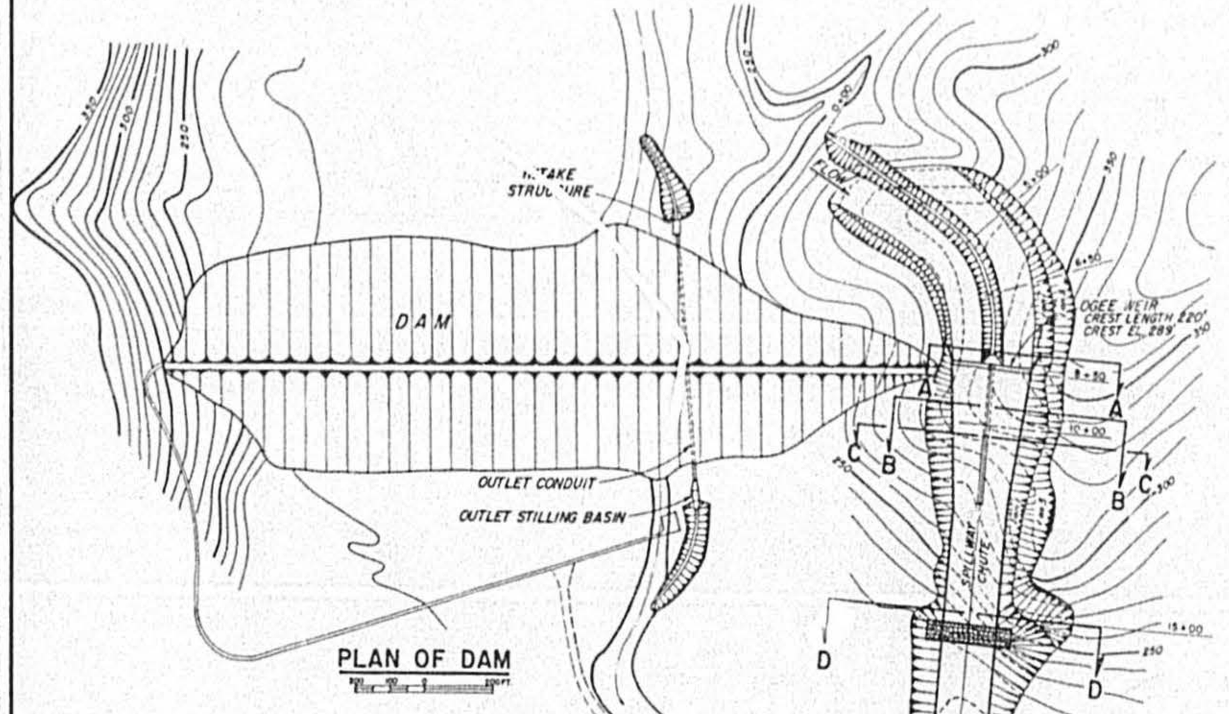
PROFILE AT AXIS OF DAM



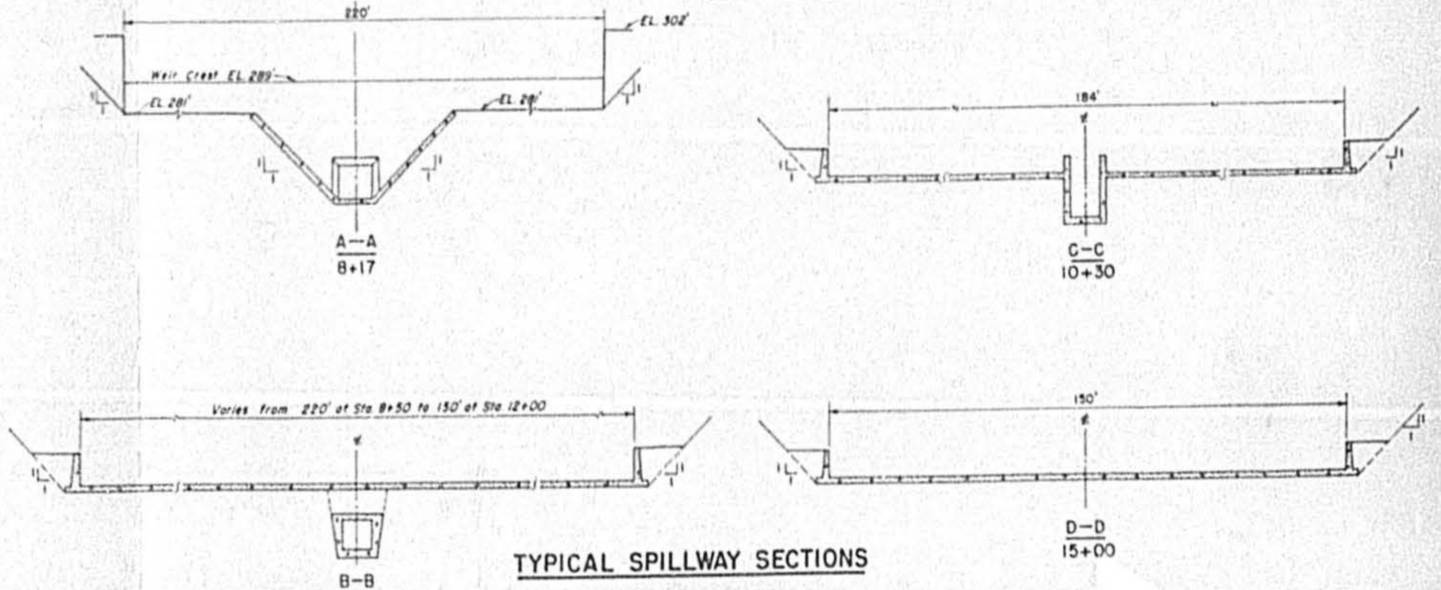
℄ SPILLWAY PROFILE



LONGITUDINAL SECTION OF OUTLET WORKS



PLAN OF DAM



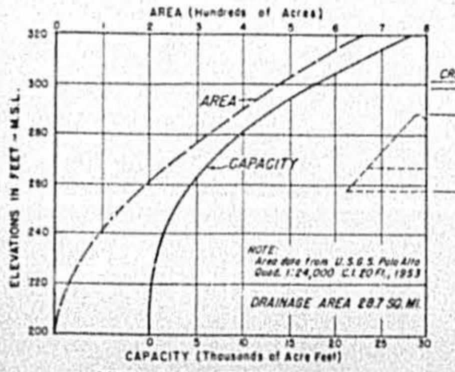
A—A
8+17

C—C
10+30

B—B
9+50

D—D
15+00

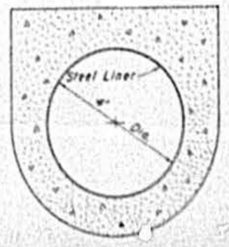
TYPICAL SPILLWAY SECTIONS



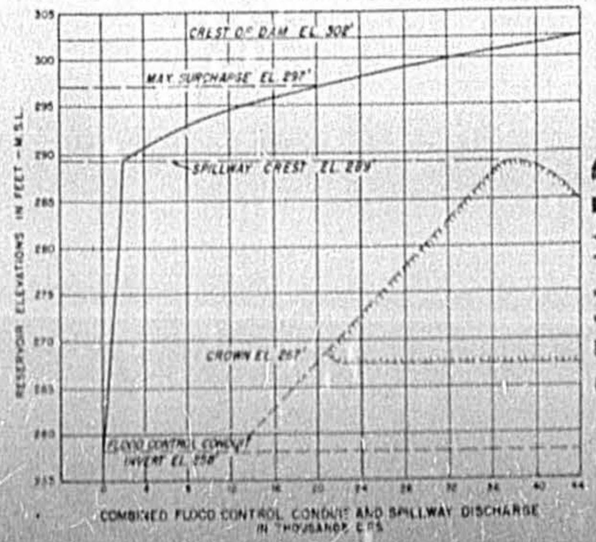
NOTE: Area data from U.S.G.S. Palo Alto Quad. 1:24,000 C.I. 20 Ft., 1953

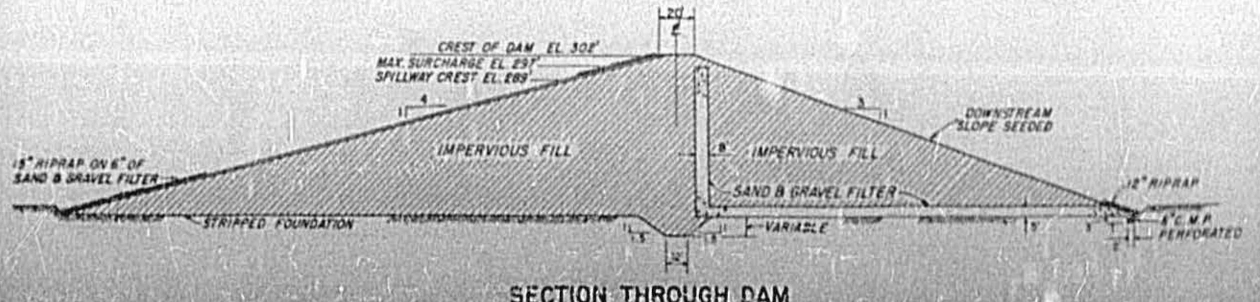
DRAINAGE AREA 28.7 SQ. MI.

AREA AND CAPACITY CURVES



OUTLET CONDUIT TYPICAL SECTION





SECTION THROUGH DAM

MICROFILMED
12-1967 33

PG 26 OF

FLOOD CONTROL
SURVEY REPORT

SAN FRANCISQUITO CREEK

SANTA CLARA AND SAN MATEO COUNTIES, CALIFORNIA

PLAN OF IMPROVEMENT

IN 2 SHEETS SCALE AS SHOWN SHEET NO. 1

U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS, 14 SEPT '60

SUBMITTED APPROVAL RECOMMENDED APPROVED

FILE NO. 72-43-1

PLATE 8